SUPPLEMENT—AUGUST 31, 1951

THE ENGINEER

Engineering and Marine Exhibition at Olympia

YESTERDAY, August, 30th, the Engineering, Marine and Welding Exhibition was opened at Olympia, London. It will remain open until Thursday, September 13th. This exhibition, which has been held on alternate years since 1906, with the exception of intervals caused by the two wars, is one of the largest shows of its kind in the world. It gives British engineering firms an opportunity to show at regular intervals advances made in equipment design, and provides potential purchasers with excellent facilities to see the products of different manufacturers side by side and compare their main features. As in previous years, F. W. Bridges and Sons, Ltd., the organisers, have arranged for an interesting social side to the exhibition, and members of the leading technical societies and various trade and other associations have been invited to attend. Indeed, no less than seventy such trade and technical associations will pay special visits during the period of the exhibition. It is particularly opportune that this event is taking place before the Festival of Britain celebrations are over, and many overseas visitors will doubtless take the opportunity to go to Olympia to see the latest products of the British engineering industry. As in previous years the exhibits and the stands are well spaced to enable visitors to inspect in comfort the plant and equipment displayed. The impression is given by the information available to us, as we go to press with this Supplement, that the proportion of exhibits shown in operation is larger than usual, and that on this occasion good use has been made of transparent plastic panels and sectional models to show internal moving parts.

Visitors will find that many of the exhibits are similar to those shown in the 1949 exhibition, apart from apparently minor modifications. Yet the result is not disappointing. For, especially amongst engineers, it is very well appreciated how the cumulative effect of relatively small individual changes can add up over the years to really startling improvements. Fundamentally, the arrangement of, for instance, vertical oil engines has not altered these twenty years and more. But what an improvement there has been in performance! Moreover, the lack of novelty in many exhibits this year can well be understood, for the extent of the demand for the tried and known existing products of many firms has severely restricted the opportunity for introducing new designs. All efforts have had to be concentrated upon filling orders rather than upon putting the new machines that are undoubtedly under development into production. Nevertheless, the exhibits, covering as they do such a wide range of engineering products, are well worth seeing by the engineer who wishes to keep abreast of modern practice. Nor do we wish to suggest by the foregoing that new products are absent. They seem only less abundant than usual.

Oil engines for both industrial and marine purposes figure, as usual, prominently in the exhibition, and the impressive range of sizes and types now available is indicative of the enterprise and healthy state of this branch of British industry. Although the reciprocating steam engine has now been almost completely superseded at the exhibition by the oil engine and the steam turbine, makers of ancillary steam plant are well represented, and the technical development work in evidence shows that steam engineering is still a very important factor in modern industry, despite the steady encroachment of the internal combustion engine in certain fields. Will we, we wonder, reflect on some future occasion how the gas turbine has superseded in its turn the reciprocating oil engine?

As a contrast to the more commercial side of the exhibition, a very interesting display has been arranged by the Department of Scientific and Industrial Research to show some of the work in progress at the different research stations it controls. In this display there are many working exhibits, and it provides an interesting insight to the development work being done by this noteworthy department in the interests of national industrial progress. This work is well supplemented by that done in the research sections of many firms which have recognised the fact that planned research is essential to industrial development and progress.

In this Supplement and articles in this issue of THE ENGINEER we have mainly concentrated upon descriptions of new developments and plant not previously shown at Olympia. These descriptions will, we think, give a fair picture of the wide scope of the exhibition and the trend of modern development. The fact that the names of some well-known exhibitors are not mentioned does not indicate that their stands are not well worth a visit, but that generally the products displayed have already been dealt with in our columns and will be familiar to readers.

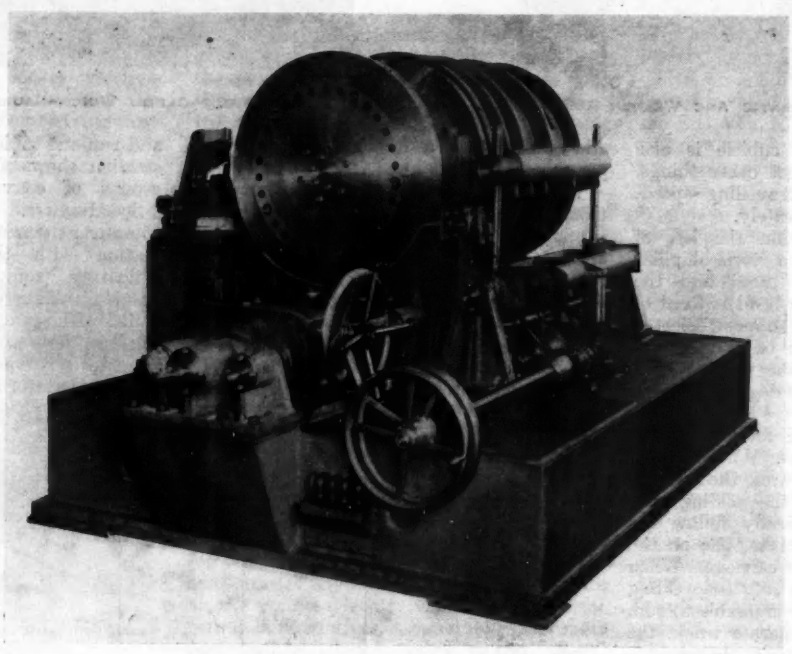

FIG. 1—WELDING HEAD OF TUBE MILL—ASEA

ASEA ELECTRIC, LTD.

A number of special machines manufactured by ASEA Svetsmaskiner A.B. of Stockholm, in conjunction with Messrs. Taylor-Winfield, of America, are exhibited by ASEA Electric, Ltd., Fulbourne Road, Walthamstow, London, E.17. The exhibits include a welding machine for a tube mill consisting of a rotating transformer with welding electrodes and electrical control gear; an automatic resistance heating and upsetting machine which heats and partially upsets blanks prior to forging or heading, and a new fully automatic arc welding machine which uses standard electrodes and is especially suitable for outdoor use as in shipyards.

The automatic arc welder, type "SVAB" (Fig. 2) is intended for welding with standard coated electrodes of any make having a length of 450mm. The operation, briefly, is as follows. The electrodes are stored in a magazine (shown on the right of our illustration) and, one by one, are automatically placed into the welding head and fed down to the joint. The length of the arc

s automatically kept constant and when one electrode is consumed a new electrode is fed from the magazine and takes over the arc. Spent electrode stumps are collected in a small box on the welding head. The magazine can be refilled during welding, thus permitting uninterrupted welding of very long joints.

There are four main parts of the automatic welder, as follows :—(1) Welding head with exchangeable magazine for various electrode diameters. (2) Operator's panel for setting of the arc length, speed of carriage, &c.; this panel contains switches for choosing the polarity of electrode, disconnecting switches for the welding current, &c. (3) Travelling carriage. (4) Welding head support. A small apparatus cubicle is also required to provide, amongst other things, coarse regulation of the travelling speed. This cubicle is mounted separately.

The travelling carriage, on the left of Fig. 2, is provided with a vertical pillar supporting the operator's panel and the welding head. The welding head is fixed to the pillar by a welding head support, selected for the kind of welding to be carried out. The operator's panel and the welding head can be turned round to 270 deg. and can be locked in certain positions.

This welder can be used for welding on flat as well as curved surfaces. When welding on flat surfaces of sufficient area, the carriage runs on the workpiece and the welding head and the carriage automatically follow the joint by means of guide rollers, one on the welding head and one on the carriage. When welding on curved surfaces or when welding work on which the carriage is unable to run, the welder travels on a separate track, the workpieces being located close to the track.

The "SVAB" automatic welder is used for welding of ship bottoms and decks, long beams, tubes, containers, and for building up welding, &c. When welding ship bottoms and decks, the travelling carriage runs on the steel plates. When welding beams, where it is generally a question of welding horizontal fillet joints, the carriage travels along a separate track and the beams to be welded are on each side of the track. In this case, the welding head is mounted to the pillar on an extension arm (as shown in our illustration) with a support enabling the head to move vertically and horizontally in relation to the carriage. Thus the beams need not be accurately aligned as the welding head can follow the joint by means of the guiding roller.

As the change of electrodes is fully automatic and the welder needs only very little attention, the operator has time for slag removal and preparation of the next weld, &c. Furthermore, he is able to tend two welders running side by side. The welder can be fed either by direct current or alternating current. When using a.c., an extra small apparatus box must be used and this box is mounted on the operator's panel.

The tube mill welding head, which forms another exhibit, is illustrated in Fig. 1. This equipment is one of a range of four sizes (as tabulated below) for welding tubes with an outer diameter from ¼in to 4in and with welding speeds up to about 45m per minute. However, to secure a tight weld the maker recommends that the maximum welding speed should be limited to 36m per minute. The high speeds refer to light gauge tubes, and at this speed a frequency of 150 cycles per second must be used.

The welding machine consists of a rotary transformer and adjustable pressure and supporting rollers. The electrode rollers are fitted directly to the secondary and thus rotate together with the transformer, which can be raised or lowered by a handwheel. The welding machine is equipped with a built-on lathe for machining the rollers. By lifting the transformer and rollers a short distance from the tube to be welded, and driving them by a separate motor, machining can be carried out without disturbing the complete mill. The flying cut-off can be supplied as a mechanical rotating cut-off, or alternatively, as an electrical tearing-off fitting.

The main parts of the equipment, i.e., forming mill, welding machine, sizing and straightening mills are mounted on separate bed-plates, thus facilitating site erection of the equipment. In the forming, sizing and straightening mills all shafts for the rollers are provided with S.K.F. bearings. Furthermore, all rollers can be adjusted vertically by means of handwheels.

LAURENCE SCOTT AND ELECTROMOTORS, LTD.

Recent developments in variable-speed electric motor drives form the basis of the display shown in operation by Laurence Scott and Electromotors, Ltd., Manfield House, Southampton Street, London, W.C.2.

In logical sequence the first exhibit is the "Speedmaster," which is the name given to a machine designed to operate as a variable-frequency converter. It is a development of the company's "N-S" variable-speed a.c. motor and it forms an efficient and compact source of variable-frequency power supply for squirrel-cage motors used as variable-speed machines. The "Speedmaster" and its associated starting and control gear is housed in a packaged unit with push buttons at the motor position to give complete control of the speed and direction of the drive. The "Speedmaster" system is especially suitable for such uses as grouped drives on conveyors and run-out tables. This particular demonstration shows the system applied to two groups of conveyor motors fed from a "Speedmaster."

Among the newer machines shown in association with the "Speedmaster" is a "floating" squirrel-cage motor designed for driving rollers on run-out tables of rolling mills. The motor (Figs. 4, 5) is "floating" in the sense that its stator is anchored only by a resiliently fixed torque rod; the rotor and stator are therefore free to accommodate themselves to any distortion on the mechanical side—for example, on the rollers or table frame. Briefly, the "floating" construction consists in making the motor an integral part of the roller shaft. As shown in Fig. 4, the rotor is built on a steel sleeve *A*, which is fitted on the roller shaft extension and is pulled up against a shoulder on the shaft by a screw *B*. This screw, which is located inside the rotor sleeve, is also used for rapid removal of the motor; for, by slackening the screw *B*, the integral collar *C* butts against the shoulder in the sleeve, forcing it away from the roller shaft.

The stator is supported on the motor bearings and is prevented from rotating by a knuckle jointed tie bar, one end of which is fixed to the motor frame and the other to the table structure. Apart from this flexible

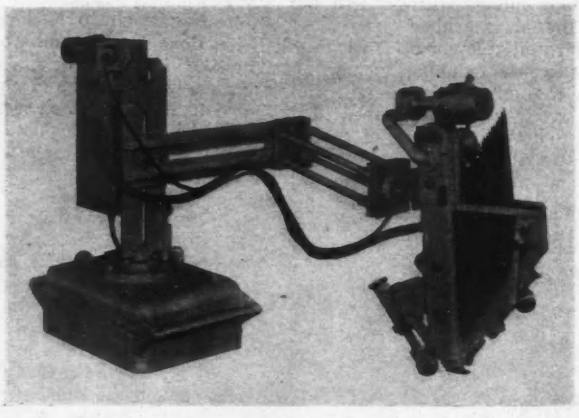

FIG. 2—AUTOMATIC ARC WELDER—ASEA

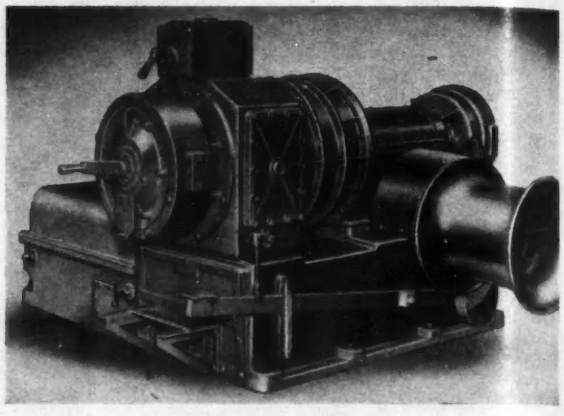

FIG. 3—CARGO WINCH—LAURENCE SCOTT

Tube Welding Mills

Size of mill	Size of welding machine	Rated input, kVA cont.	Electrode pressure, kg	Max. outer dia. of pipe, mm	Stock thickness, mm		Max. welding speed, m/min*
					Min.	Max.	
1	0	80	1000	38	0·80	1·50	30–24
2	1	150	2000	50	1·00	2·25	36–23
2	2	250	5000	76	1·00	4·50	36–10
3	3	350	7000	115	1·25	5·00	36–14

* These figures correspond to the minimum and maximum values for stock thickness respectively.

link to the table, the motor has no fixed mounting. It is free to float on the roller shaft extension and, therefore, cannot be harmed by distortions of the roller, roller shaft or table structure. Since the sleeve provides the only solid contact with the drive the motor tends to move as a whole in response to sudden impacts, which are therefore less likely to cause damage than in a flange-mounted motor driving through gears or a flexible coupling.

Normally, the motors are fed from busbars run in the table structure, with individual junction boxes for each motor. A flexible

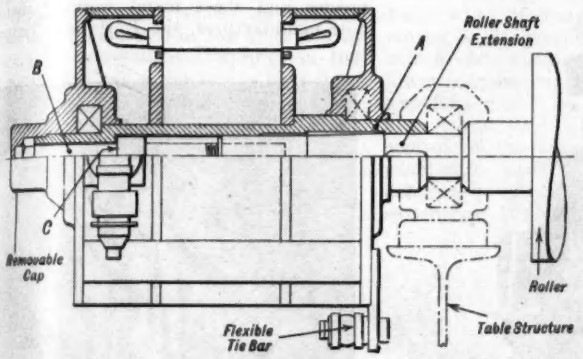

FIG. 4—FLOATING ROLLER TABLE MOTOR—LAURENCE SCOTT

cable connects the junction box to a plug and socket on the motor. Any motor can be isolated without stopping the remaining motors, by removing the socket which is, itself, then protected by a threaded cap. A typical roller table drive embodying floating motors is illustrated in Fig. 5.

Roller motors usually run at comparatively low speeds and the use of a low supply frequency does away with the necessity of having motors with a large number of poles.

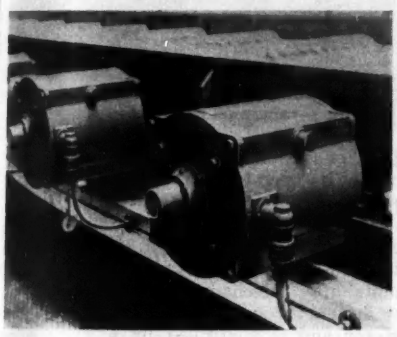

FIG. 5—"FLOATING" MOTOR ROLLER TABLE DRIVE—LAURENCE SCOTT

A convenient source of supply of variable low frequency current is provided by a "Speedmaster" as mentioned above.

Another new development demonstrated by the same company is electronic control of its "N-S" variable-speed motors. The function of the speed control equipment is to vary the setting of an induction regulator to maintain the desired speed of the "N-S" motor, or to vary its speed according to the requirements of the drive. In its simplest form the control gear consists of a potentiometer which is fed from a stabilised d.c. supply and is hand set to give the desired speed. The difference, if any, between the desired speed and the actual motor speed is then given by the difference between the potentiometer voltage and the voltage generated by a tachometer generator coupled to the "N-S" motor shaft. This difference in voltage is fed to an amplifier with two output circuits connected to the two opposed field windings of a d.c. servo-motor driving the induction regulator. The differential voltage unbalances the currents in the two field windings and creates a magnetic field which, reacting with a constantly flowing d.c. armature current, causes the motor to rotate in a clockwise or anti-clockwise direction according to the sense of the unbalance. The servo-motor is suitably geared to the induction regulator, which is driven to a position corresponding to the set speed of the main motor. In this position the voltages across the potentiometer and the tacho-generator become equal and in consequence the field of the servo-motor becomes zero, the servo-motor stops, and the movement of the induction regulator ceases. A stabilising device operated by the servo-motor eliminates any tendency to hunting even under the conditions of high sensitivity obtained.

The equipment is designed to control speed to within plus and minus 2 r.p.m., with supply voltage or frequency variation of plus and minus 10 per cent and variations of load from zero to full load.

The complete starting and controlling apparatus, including the induction regulator, can be housed in a "packaged" unit consisting of a cubicle with a hinged door. A small control panel mounted, at about waist level, on a substantial pillar, is provided near the driven machine.

Another interesting exhibit on the same stand is the "Scott N-S" electric cargo winch (Fig. 3), which incorporates the "N-S" variable-speed a.c. motor and is designed for use in ships having a.c. supplies to the auxiliaries. It occupies the same deck space as the company's d.c. winch of equivalent rating, and it gives substantially the same performance. Speed control in the "N-S" winch is achieved through a tapped induction regulator housed in the winch bed-plate, in the position normally occupied by the series resistances of a d.c. winch. A master controller housed in a box on top of the motor provides three hoisting speeds, the associated contactors being accommodated in a compartment in the bed-plate. Lowering speed is controlled in the normal way either by using the foot brake, which can be seen in Fig. 3, or by releasing the hand brake lever when lowering by gravity. A centrifugal overspeed brake is fitted.

SIR GEORGE GODFREY AND PARTNERS (INDUSTRIAL), LTD.

For some years now Sir George Godfrey and Partners (Industrial), Ltd., of Hanworth, Middlesex, have specialised in the design and manufacture of industrial blowers, vacuum pumps, gas boosters and superchargers of the Roots type. These units, which carry the trade name "Marshall," are made in a standard range, with flows from 10 to 6000 cubic feet per minute at pressures up to 10 lb per square inch, and in a number of special forms for particular applications. As a result of the experience gained with this type of blower considerably higher rotor speeds than were once thought practicable are used to give higher efficiencies in the industrial models.

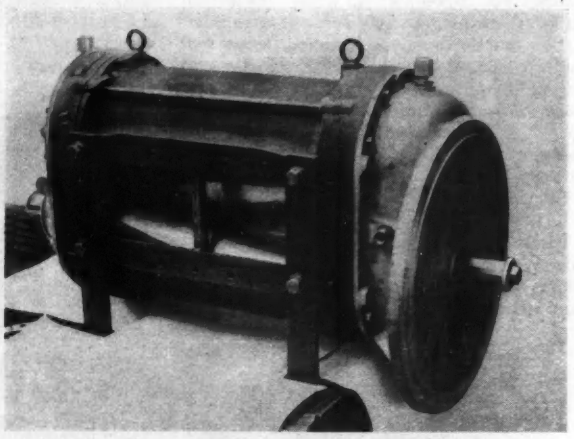

FIG. 6—INDUSTRIAL BLOWER—GODFREY

One of the units exhibited for the first time by the makers is the "M 2000" blower illustrated in Fig. 6. This blower is used on an air-conditioning trolley designed and built by the company in collaboration with the B.O.A.C., to supply hot or cold air under pressure for conditioning aircraft whilst they are standing on aerodromes. The compressor is of the maker's positive displacement Roots type and it supplies 1500 cubic feet of air per minute at pressure up to 12 lb per square inch. In order to meet tropical conditions with the equipment the compressor has been specially designed to supply air at a higher pressure than the standard units. For this class of work the design of compressor is particularly adapted as it requires no oil lubricant in the blower chamber, and the air is supplied to the aircraft quite free of contamination.

In this air-conditioning set the blower has involute rotor blades of helical form, and it is driven by a Rolls-Royce petrol engine developing 160 b.h.p. at 3500 r.p.m. The rotor shaft is driven through a flexible coupling from the crankshaft of the engine. At the drive end of the blower a large circumferential flange is cast integral with the end cover plate, and this flange fits on the flywheel housing of the engine.

Also to be seen upon this stand is a supercharger of new design which was specially developed for use on the Rolls-Royce diesel engine used on the Vickers tractor. In this unit the principle of rotary displacement has been retained, but the inlet and outlet ports have been arranged to suit axial-flow delivery. It is of particularly rigid construction to comply with the heavy duty requirements of the tractor and its rotor blade length is short in comparison with the rotor centres.

W. H. DORMAN AND CO., LTD.

In addition to an engine of new design, W. H. Dorman and Co., Ltd., of Stafford, is exhibiting an example of a "6 DLM, Mark III" six-cylinder, direct-injection marine diesel engine, developing 102 b.h.p. at 1200 r.p.m., complete with twin disc forward and reverse gear, and a "4 BK, Mark II" four-cylinder, direct-injection industrial

diesel engine, of 45 b.h.p. at 1500 r.p.m. The four-cylinder engine has cut-away sections to show its internal construction and cycle of operations. The new engine, which is being shown for the first time, is a six-cylinder, direct-injection, non-pressure-charged industrial diesel unit, Mark 6KA, having a 135mm bore by 160mm stroke, and developing 160 b.h.p. at 1500 r.p.m. The general appearance of the engine is shown in our illustration, Fig. 7, and we reproduce in Fig. 8 a set of curves which give a record of the performance of the engine.

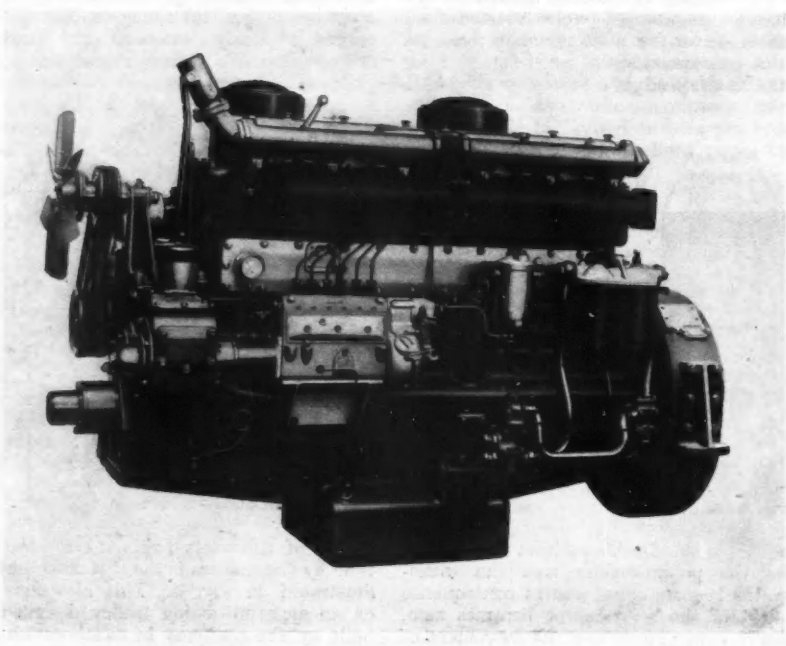

FIG. 7—160 B.H.P. OIL ENGINE—DORMAN

This six-cylinder, in-line, four stroke, water cooled, compression ignition engine has been designed for installation in almost every type of industrial plant, three point suspension being adopted. Its cast iron crankcase is divided below the centre line of the crankshaft and the lower half forms a lubricating oil reservoir having a capacity of 7 gallons. The cylinders are cast as a unit, and are fitted with wet liners having chrome-hardened bores. Cast in two units, the cylinder heads incorporate two valves per cylinder, the inlet valve being shrouded for turbulence, rocker mechanism, which includes a decompression device, and fuel injectors. Replaceable valve seat inserts are provided and there is a detachable cover over the rocker mechanism.

Cast aluminium alloy pistons having a toroidal combustion chamber are fitted and have three pressure rings, two slotted scraper rings and a push fit fully floating gudgeon pin carried in steel-shell bushes lead-bronze lined, and located by circlips. The connecting-rods are stampings of 55/65 ton steel having steel-backed lead-bronze-lined small-end bushes and copper-lead, steel-backed big-end bearings. To allow the connecting-rod to be withdrawn through the cylinder bore the big-end is split at an angle of 45 deg. A special high-duty cast-iron crankshaft is supported in seven steel-backed copper-lead bearings of ample proportions. Fitted in the crankcase and carried in seven bearings is the case-hardened steel camshaft, the cams on which operate the valve gear through mushroom-headed tappets and push rods.

The direct-injection system is used and fuel is supplied to nozzles set at 175 atmospheres through a large capacity filter, by a C.A.V. injection pump fitted with a centrifugal governor. The compression ratio is 15·2 to 1 and the compression pressure is 520/530 lb per square inch, while the maximum pressure is 1000/1035 lb per square inch. Lubrication is by a gear pump driven through helical gearing from the camshaft, the oil being drawn from the reservoir in the crankcase through a strainer and delivered to the main relief valve. From this point the oil passes through a Vokes twin-element, full-flow filter to the main gallery pipe, from which supplies are delivered to the main, big-end and camshaft bearings, timing chain and cylinder head. When an oil cooler is fitted a shunt valve is incorporated in the system to protect the cooler against increased pressure due to cold oil.

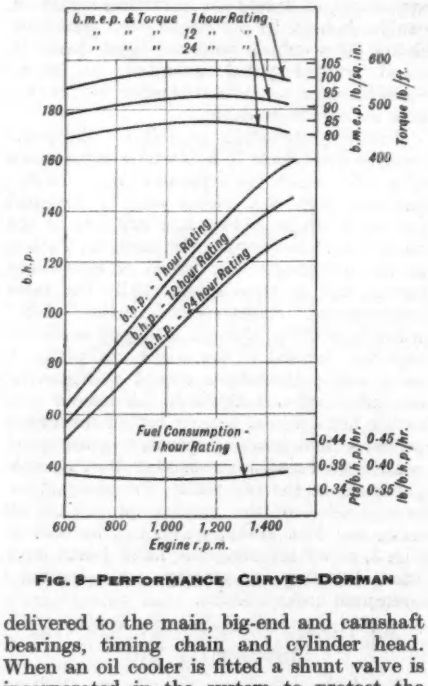

FIG. 8—PERFORMANCE CURVES—DORMAN

Mounted on the offside of the engine is a centrifugal pump which circulates cooling water, through the cylinder blocks and hea to an outlet pipe which is provided with thermostat. The C.A.V. electrical starti provided in association with a hand-operate decompressor consists of a 6in diameter ari starter, a 5in diameter dynamo having maximum output of 288W at 12A, th minimum battery capacity required bein 100Ah at ten-hour discharge rating.

The engine, which has a net weight about 28 cwt, is approximately 6ft 7in long 3ft wide and 5ft high.

BUTTERLEY COMPANY, LTD.

As a representative example of the powe presses and sheet metal working plant i now manufactures, the Butterley Company

FIG. 9—INCLINABLE PRESS—BUTTERLEY

Ltd., of Butterley, near Derby, is exhibiting one of its open-fronted, ungeared, inclinable presses.

This machine, as can be seen in the photograph above (Fig. 9) is of simple straightforward design, and its main component units are "Meehanite" iron castings. It is driven through vee belts from a 5 h.p. motor and is controlled by a single roller key clutch for either non-repeat single stroking or continuous running. Rated to give up to ninety strokes per minute, the machine is designed to exert a pressure of 40 tons near the bottom of the stroke, which is

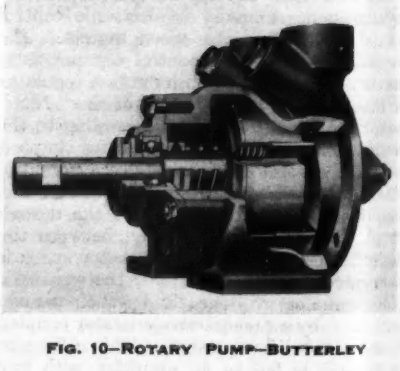

FIG. 10—ROTARY PUMP—BUTTERLEY

riable between 1in and 4½in. The ram oves between long slides, which give it ll support in all positions, and it has a nd die stalk hole and clamp, with side lt lugs to give additional die support. A 3in thick tee-slotted bolster supplied ith the machine is 17½in by 28in, and when t on the table the distance from its upper rface to the ram guides is 11½in.

Also to be seen upon this firm's stand are amples of the Butterley-Warren pump, hich is shown in section in Fig. 10. These nits for pumping water, clear liquids, and in oils, are made in six sizes from ¾in 3in, and of capacities from 200 to 4000 llons per hour.

In these pumps the vanes are held in ntact with a cam face at the inner end of e body by stainless steel springs in the tor unit. The vanes move in a horizontal ane and do not depend upon centrifugal rce for their operation, and any wear is tomatically compensated for.

The pumps run in either direction with ual efficiency and reversal of suction and elivery is effected simply by turning the end cover plate, which carries the cam face, through 180 deg.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, LTD.

A recent addition to the range of crack detectors manufactured by the Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester, 17, is to be seen on this company's stand.

The equipment, which is illustrated in Fig. 11, is known as the Universal Magnetic Crack Detector, type "S." It provides means of longitudinal and circumferential magnetisation, by means of a d.c. electro-magnet and heavy a.c. current respectively, enabling surface cracks in magnetic materials, whatever their direction, to be found in one operation. In certain circumstances internal faults can also be detected.

The detector is suitable for the examination of magnetic articles up to 48in in length and about 25in in peripheral length; longer articles can be examined in two or more operations.

The equipment consists of a robust floor-mounted, sheet-steel cubicle surmounted by a horizontal steel bed-plate carrying two movable pole-pieces provided with d.c. magnetising coils, vee blocks and clamps. The cubicle is approximately 5ft 6in long, 3ft 5in high and 1ft 4in deep. The left-hand pole-piece is freely movable over the full length of the bed-plate and can be locked in any position. The right-hand pole-piece is provided with a short lead screw operated by a handwheel at the right-hand end of the cubicle; thus components may be held between the pole-pieces by means of end pressure. Beneath the bed-plate is a drip tray and sump for magnetic fluid, from which the fluid can be applied to components undergoing test by means of a non-magnetic ladle. A brass splash shield clips on to the front edge of the cubicle, and may be moved to any position along it. Within the cubicle are mounted a metal rectifier, a heavy current transformer, an instrument transformer, a "Variac" for control of the d.c. circuit, and a second "Variac" for control of the a.c. circuit. On the front panel of the cubicle are mounted the various instruments and controls. An ironclad mains switch-fuse is mounted on the right-hand end of the cubicle, and operation of the machine is controlled by a master foot switch, which energises the main contactor within the cubicle. The d.c. and a.c. output are brought out to the magnetising coils and pole-pieces through cables which are armoured where necessary. The complete apparatus is arranged for operation from a single-phase a.c. supply.

The object to be examined is clamped between the pole-pieces and subjected to successive magnetisation by the magnetising coils carried on the pole-pieces and by a a heavy alternating current of appropriate value, passed through it. The application of magnetic fluid during magnetisation reveals all surface cracks, whatever their direction. If the object to be examined is hollow, a conductor can be threaded through it and the current passed through the conductor instead of through the object. By this procedure cracks in the hollow bore can be shown.

When the circumstances do not call for the use of dual magnetisation, either the d.c. or the a.c. magnetising circuit may be used alone, the two circuits being quite independent. The former makes possible the location of cracks that are roughly transverse to the axis of the equipment, and the latter will reveal those that are substantially longitudinal.

Objects may be held by the vee blocks and clamps, or between the edges of the pole-pieces by means of end pressure. Alternatively, special pole-pieces may be made to suit any particular component.

After an article has been examined in the type "S" crack detector, complete demagnetisation can be achieved by exactly balancing the residual magnetism by a d.c. flux passed in the reverse direction. A d.c. reversing switch is provided for this purpose, the exact value of reverse magnetisation being found for any component quite easily by trial and error, and controlled by the d.c. circuit "Variac." If the component is not completely demagnetised by this procedure, it should finally be subjected to diminishing a.c. through-current.

Another exhibit makes use of a model to show the application of electronic control to the "take up" or "let off" drive for a reel of continuous material, where the material is fed on or taken off the controlled reel by an uncontrolled motor drive. It illustrates very simply a problem frequently encountered in the textile, paper-making and many other industries, namely, the control of the speed of the reels to suit the linear speed of a continuous strip of material.

The uncontrolled motor (referred to as motor *A*) is, in practice, a constant-speed machine, although for demonstration purposes a form of speed control is provided. This motor drives a reel, and is reversible, allowing the material to be run on or let off the reel, as desired. The other motor *B* drives a similar reel, but is a wide-range, variable-speed drive controlled by a "Metrovick" electronic control equipment, type "ECT 50/M" (Fig. 12), which employs thyratrons and a magnetic amplifier. A dancing roller is situated in a loop in the material strip, between the two reels. As both motors drive their associated reels, there will be a progressive change in the linear speed of the strip, concomitant with the change in diameter of the material on the uncontrolled reel *A*. The speed of reel *B* must, therefore, be varied to allow for this change in the linear speed of the material

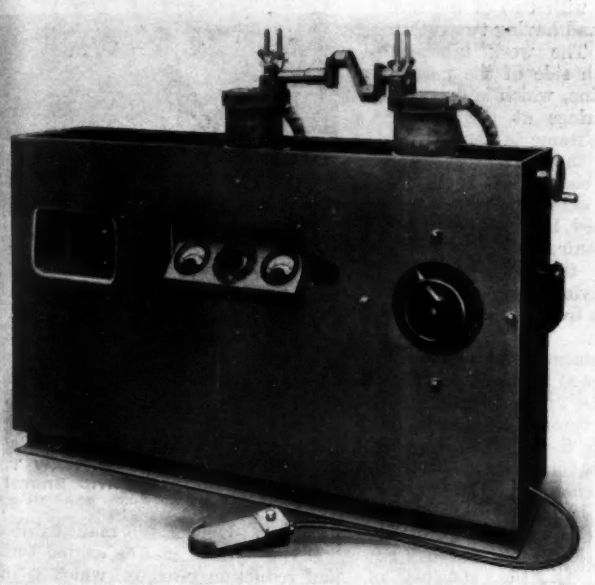

FIG. 11—UNIVERSAL CRACK DETECTOR—METROPOLITAN-VICKERS

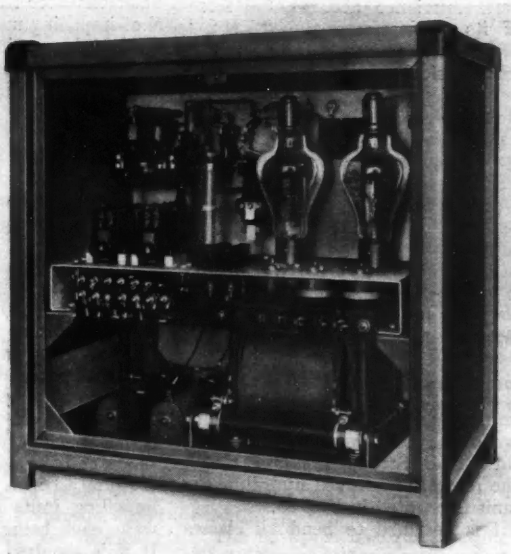

FIG. 12—ELECTRONIC EQUIPMENT FOR CONTROLLED REEL DRIVE—METROPOLITAN-VICKERS

and also for the progressive change in the diameter of the material on reel *B*.

The exhibit demonstrates the difficulty of controlling such an arrangement manually, but shows that the dancing roller provides adequate control automatically and with complete stability, whether the controlled reel is acting as either a take-up or a let-off drive. Provision is made for loading the dancing roller with various weights to demonstrate that the equipment provides also a very effective method of controlling the tension in the material strip. It may be noted that the only consumable components used in the electronic control equipment are the two thyratrons.

The exhibit is designed for a maximum linear speed of strip of 100ft per minute; a build up on each reel of 3/1; a speed variation on motor *A* of 2/1. Fractional horsepower motors are used for demonstration purposes, but the same scheme can be applied to full-scale industrial drives.

A new exhibit of considerable technical interest is the 55kV electron microscope (type "EM 4") which is fully described elsewhere in this issue. This instrument is based on experience accumulated from the use of its predecessors, the "EM 2" and "EM 3" electron microscopes, but there is no physical resemblance between the earlier versions and the new equipment. The "EM 4" microscope has been designed particularly as an inexpensive instrument for routine work in factory or laboratory. It is capable of providing magnifications up to 12,000 with a resolution better than 100 Angstrom units. The complete instrument is enclosed in a single rectangular desk or cubicle, measuring 2ft 6in by 2ft 6in by 3ft 2in high, and is equipped with simple plugs for connection to standard factory electricity mains.

LAWLER, AYRES AND CO., LTD.

The useful range of pipe-bending equipment shown by Lawler, Ayres and Co., Ltd., of 54, Old Broad Street, London, E.C.2, includes the recently improved hydraulically operated unit illustrated in Fig. 13.

This unit is designed to bend all classes

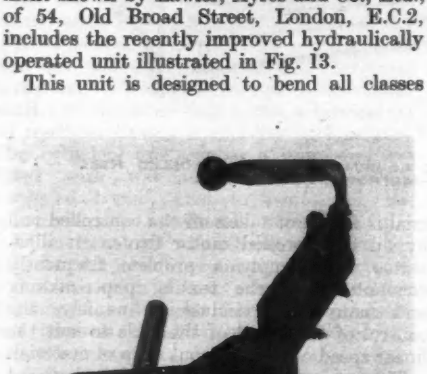

FIG. 13—PIPE BENDING MACHINE—LAWLER

of heavy steam, gas or water barrel up to 2in diameter, or, with the use of a former head attachment, up to 3in diameter. Pipes cold and unloaded can be bent to angles up to 90 deg. and with an extension ram up to 160 deg. An extreme bending set which is also available makes it possible to make 180 deg. return bends for all diameters up to 2in.

The hydraulic power unit of the bender has a solid, high-tensile steel ram, and its stroke is 10½in. When the bending operation on a tube has been completed the fluid feed to the hydraulic cylinder is reversed by means of a small thumb catch and the ram is retracted by power. The bender frame of heavy steel plate is drilled to take the formers for the various tube sizes and the angle settings.

Formers for ¼in, ¾in and 1in diameter tubes are manufactured from close-grain cast iron, and those for the larger sizes of tubes from steel.

TILGHMAN'S PATENT SAND BLAST COMPANY, LTD.

One of the largest pieces of equipment on the stand of Tilghman's Patent Sand Blast Company, Ltd., of Broadheath, near Manchester, is a "Wheelabrator" table shot blast machine similar to that shown in Fig. 14.

This machine consists essentially of a shot blast chamber fitted with two of the firm's shot impelling units and having two rotating work table units. The work tables are mounted one on each side of the partition or door of the machine, which is carried on central vertical bearings at the top and bottom on the front frame of the machine. In operation, whilst the workpieces on one table are being shot blasted in the chamber, the pieces on the other table are being unloaded and replaced by other work. At the end of the cleaning period the front partition is rotated through 180 deg. to bring the table carrying finished work out and replace it with a fresh batch of work on the other table.

Each of the two rotating work tables is 6ft diameter and is designed to take up to 2 tons of work which can be up to 3ft high. The tables are driven through a chain and sprocket whilst inside the blasting chamber, the table drive being cut out when the partition is swung to open the chamber. The two shot impelling units are 19½in diameter by 3in wide, each being driven by a 15 h.p. motor. If it is required to clean large castings not completely covered by the streams of shot from the wheels, pressure shot blast units can be provided with the equipment

The plant is stated to be quite dustproof in operation, and it is fitted with a sand/shot separator to ensure that only clean abrasive is returned to the shot hoppers.

This firm is also showing a liquid honing cabinet for imparting very fine finishes to ground surfaces.

DAVID BROWN CORPORATION, LTD.

On the stand of the David Brown Corporation, Ltd., of Huddersfield, is shown a representative selection of the organisation's

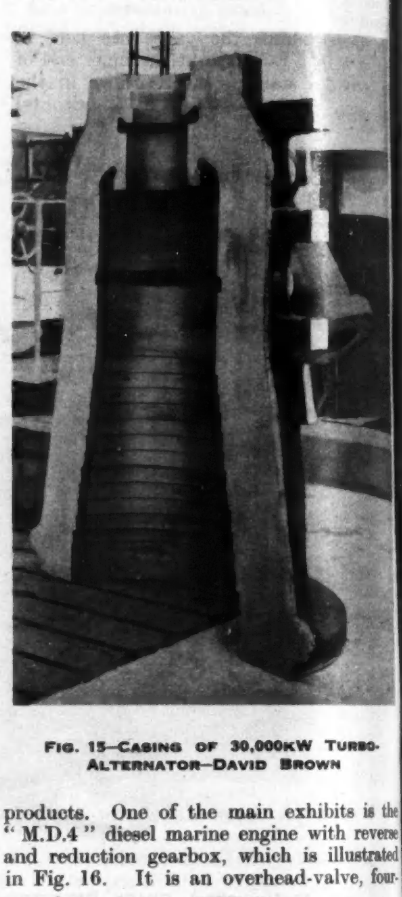

FIG. 15—CASING OF 30,000kW TURBO-ALTERNATOR—DAVID BROWN

products. One of the main exhibits is the "M.D.4" diesel marine engine with reverse and reduction gearbox, which is illustrated in Fig. 16. It is an overhead-valve, four-

FIG. 14—TWIN TABLE SHOT BLAST MACHINE—TILGHMAN'S

stroke, four-cylinder engine having a bore of 3½in by 4in stroke, developing 25·5 b.h.p. at 1600 r.p.m. It is produced by David Brown Tractors, Ltd., and designed for powering motor cruisers, fishing boats and barges.

The cylinder block and crankcase is a monobloc casting in high-duty nickel-chrome cast iron, the crankcase having separate main bearing caps and the cylinder block having machined in it bearings for the camshaft. The oil gallery is integral with the casting and inspection doors are on the tappet side. A monobloc nickel-chrome casting incorporating a water-distributing tube, a rocker shaft and support bearings forms the cylinder head. The inlet and exhaust ports are arranged tangentially to set up a swirl which assists in ejecting the exhaust gases. Close-grained cast iron wet liners are provided and sealed at top and bottom. The sump is of cast iron and holds 3 gallons of oil.

Cast silicon alloy pistons are supplied and have a toroidal combustion chamber machined in their crowns. They are fitted with three compression rings and one scraper ring, the fully floating gudgeon pin being held by circlips. The connecting-rods are steel stampings and have thin shell copper-lead, steel-backed, big-end bearings, while the forged nickel-chrome molybdenum steel crankshaft has three bearings with copper lead, steel-backed shells in the lower halves, and white metal in the upper halves. The crankshaft is drilled for pressure lubrication to main and big-end bearings, and all its journals are hardened by the electrical induction process. Driven by single helical steel and cast iron splash-lubricated gears, the cast Monikrom camshaft has ground cam profiles and bearings. It operates silicon-chrome steel valves, working in nickel cast iron guides, through hollow steel push rods having hollow chilled cast iron tappets.

A pump injects fuel through four-hole nozzles and is supplied by a plunger feed pump, cam operated from the injection pump camshaft, while a pneumatic governor operates the pump control rod. Pressure lubrication is by means of a gear oil pump and cooling is arranged on the open water system thermostatically controlled. Starting is by hand or by a 12V electric motor combined with the use of a decompressor.

The transmission unit is a direct-drive, reversing gearbox fitted with an optional reduction gear made by David Brown Gears (London), Ltd.

As an example of the work of the foundries group there is on the stand the bottom half of a high-pressure steam turbine casing, in cast steel, and weighing approximately 3 tons. This casting, which is shown in Fig. 15, is for a 30,000kW turbo-alternator which forms part of the electrical generating plant intended for the Orlando power station, Johannesburg.

British Oxygen Company, Ltd.

The many interesting demonstrations of cutting and welding plant which have been arranged include one of the recently developed "Multifloat" attachment of the plate edge preparation machine made by the British Oxygen Company, Ltd., of Bridgewater House, Cleveland Row, London, S.W.1. With this unit the radii of one edge of a plate can be cut whilst straight or other curved cuts can be made simultaneously on its other edges ready for welding without subsequent machining.

A cutting machine fitted with the new attachment can be seen in operation in Fig. 17, where a curved edge on a ship's plate can be seen in course of preparation. The basis of the machine is a variable-speed reversible tractor operating on ordinary workshop power supplies and running on a standard track. A speedometer provided on the unit is calibrated in feet per hour and the tractor maintains a preselected speed within close limits. The track width of the tractor wheels is 10in and the machine will run either on the flanges of a standard R.S.J. or, if preferred, on a built-up track.

On top of the tractor and at right angles to the track is a sliding arm, on the end of which is a floating link mechanism carrying the cutting nozzle and the plate riding roller. This roller runs on the surface of the plate to be cut and maintains the correct distance between nozzles and plate.

The sliding arm is moved by a flexible steel wire riding over jockey pulleys and loaded by a weight suspended in a tube on the opposite side of the machine from the cutting head and link mechanism. The length of the arm is adjustable and it can be locked for straight cuts. When the arm is unlocked the action of the weight automatically extends the arm inwards over the plate. At the foot of the cutting head there is a bracket carrying two horizontally disposed rollers. When it is required to cut a curved edge along a plate, these rollers bear against a steel strip laid on the surface of the plate and kept in the desired position by means of a number of small permanent magnets, as shown in the illustration. The magnets are spaced at about 10in intervals and the steel strip is sufficiently flexible to enable curves of reasonably small radius to be followed accurately. This method of fixing the guide strip enables small adjustments to be made with speed and accuracy.

Extension of the arm by means of a weight ensures that the rollers bear upon the guide strip with the same pressure irrespective of the amount of arm protruding from the tractor.

The rollers are in close proximity to the cutting nozzles during cutting, and air lines are arranged to project a cooling stream of compressed air upon them during working.

Two new blowpipes are also being shown by British Oxygen Company, Ltd., one, the "Cutogen" No. 5, is intended to cover the majority of general-purpose cutting for fabrication and scrap work, and is designed for cutting mild steel up to 12in thickness. With suitable nozzles and attachments it can be used in addition for gouging, rivet washing, piercing and powder cutting. One-piece nozzles are fitted and the blowpipe is suitable for use with acetylene, propane and other fuel gases when appropriate nozzles are fitted.

The blowpipe has quick-action ball-ended positive stop fuel gas valves and an underslung lever cutting gas control valve.

It is strengthened by the use of a stainless steel top tube, which carries the cutting oxygen. By using an internally threaded head for nozzle fitment the threads are protected from damage, and it has been possible to make the exterior of the head smoother so that it is less likely to offer lodgement for dirt, spatter, &c.

The "Cutogen" No. 5 is supplied in two standard lengths, measured between the centre line of the fuel gas control valves and the nozzle, namely, 18in and 24in. The 18in model is fitted with a 90 deg. head, whilst the 24in has a 75 deg. head. Non-standard models can be supplied with shank lengths varied in increments of 6in, and special angle heads are available to order for gouging, &c.

Of somewhat similar construction is the firm's new "Cutogen" No. 3, which is intended for cutting mild steel up to 20in thick and cast iron up to 15in in thickness, which can be used with acetylene, propane and other fuel gases.

National Gas and Oil Engine Company, Ltd.

Among the wide range of engines shown in operation by the National Gas and Oil Engine Company, Ltd., of Ashton-under-Lyne, is a Mark "F 4 AUM 6" four-stroke,

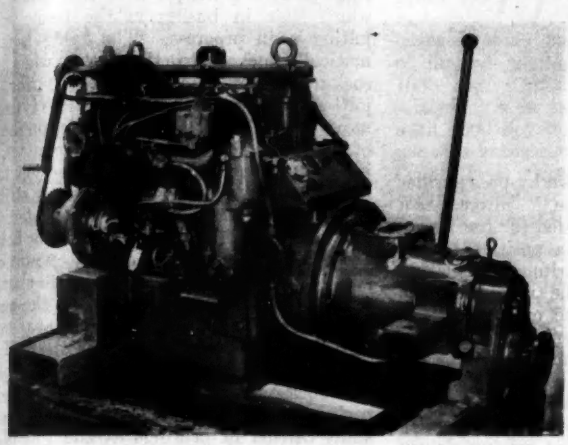

FIG. 16—25 B.H.P. MARINE ENGINE—DAVID BROWN

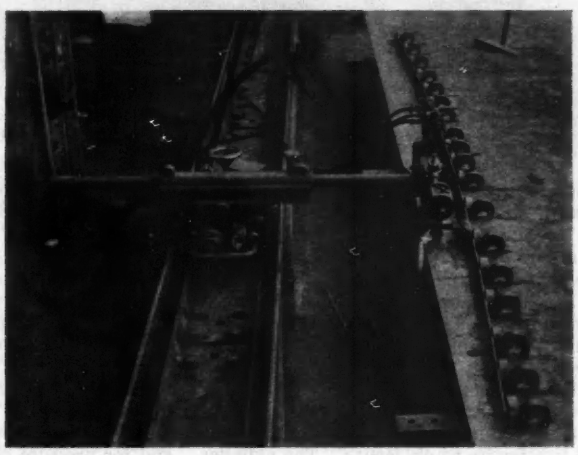

FIG. 17—PLATE EDGE PREPARATION MACHINE—BRITISH OXYGEN

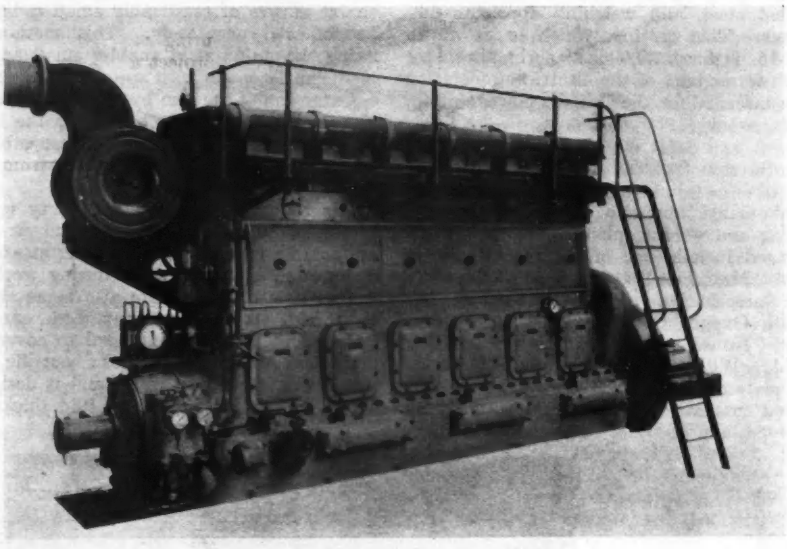

FIG. 18—624 S.H.P. MARINE OIL ENGINE—NATIONAL

pressure-charged, marine propulsion unit (shown in Fig. 18) having six cylinders of 12in bore by 15in stroke. With the engine turning over at 500 r.p.m., it develops 624 s.h.p., and drive is transmitted through a flexible coupling and an oil-operated reverse reduction gearbox with a 4 to 1 standard ratio.

The cast one-piece bed-plate is machined top and bottom and water spaces are provided under the main bearings for oil cooling. Bored to receive loose liners the column, which is cast in one piece, is bolted to the bed-plate for its whole length. The cylinder liners, which are interchangeable, are registered in the column and held down against a joint by the cylinder head, while their bottom ends are free to expand. The high-duty cast iron cylinder heads incorporate two inlet and two exhaust valves, vertically mounted, each having separate passages designed to create maximum turbulence and give good combustion and high thermal efficiency. Valve guides are fitted as well as high-duty cast iron inserts for the valve seats.

Four pressure and two scraper rings are fitted to each piston and the floating gudgeon pin is case hardened and ground. The connecting-rods, which are alloy steel stampings, are drilled to allow for pressure lubrication of the gudgeon pin. The bearing at the small-end is of phosphor-bronze, while that at the big-end is of the marine type with the steps lined with white metal. The crankshaft, which is machined from a 34/38-ton mild steel forging, is exceptionally stiff and has a high natural frequency of torsional vibration, while at major critical speeds the vibration stresses are low. The bearings are white-metal-lined shells of round backed pattern and can be removed without lifting the crankshaft. The camshaft fitted with hardened steel cams is gear driven from the crankshaft, and operates the valves through levers and push rods, the valves having double springs, heat-resisting steel spindles and "Stellited" exhaust faces.

A separate fuel pump is fitted to each cylinder and adjustable case-hardened cams permit a small range of injection timing. Spring-loaded needle atomisers are provided and a reasonable needle temperature maintained by water cooling. Oil is supplied to all bearings and valve-operating mechanisms by a gear pump, at a pressure of 20/25lb per square inch, which is controlled by an automatic by-pass valve. A full-flow strainer is fitted and there is a by-pass purifier incorporating "Streamline" filters. An oil priming pump is included for use before starting up. For cooling a positive supply of water assisted by a centrifugal circulating pump is passed under the main bearings through the column to the cylinder heads. A high velocity of flow ensures maximum heat transfer and, as the main bearings are water-cooled, no oil cooler is required.

Starting is by compressed air admitted to the cylinders through a non-return valve and for pressure charging an exhaust-driven turbo-blower is mounted.

J. W. JACKMAN AND CO., LTD.

As a background to representative samples of its moulding machines in the foundry section of the exhibition, J. W. Jackman and Co., Ltd., of Vulcan Works, Manchester, has installed one of its sand-preparing plants.

In this plant the sand first passes over a mechanical sieve, on which the coarse material is removed, and then over a magnetic drum for the removal of any iron and steel. From the drum the sand is delivered into a skip hoist which raises and discharges it into a mill. In this mill a conical roll revolving on a sloping pan imparts a rubbing action to the sand grains without breaking down their angularity. At the same time scrapers on the pan turn over and mix the sand and uniformly distribute the bonding material. The prepared sand is discharged from the pan to a disintegrator, whence it is transported to the moulding stations.

An "Osborn" rock-over jolt machine on this firm's stand is illustrated in Fig. 19. In this machine a single valve is used to control the jolting, vibrating and pattern-draw operations. The main frame carrying the rock-over and box clamping gear is mounted centrally on the bed-plate between the jolting and pattern-drawing mechanisms. The table, on which are mounted the pattern plate and box, is carried by the rock-over frame, and is provided with four guide pins which slide in bushes in the frame while jolting is in progress. The table is automatically locked to the press when the rock-over movement begins. During the jolting operation the rock-over table is free to move vertically with the jolt table, on the top of which its lower face makes contact. A jolt piston cast integrally with the jolt table makes impact at its lower end on a striking plug at the base of the jolt cylinder.

Two arms, which are adjustable for height, are mounted on vertical shafts, one on each side of the frame, and a pneumatic clamp is fitted at the end of each arm. At the end of the jolting operation the arms are swung into position for their clamps to hold the bottom board, moulding box, pattern plate, and rock-over frame rigidly together. The rock-over frame is bolted to a cast steel cross shaft carried in bearings at the top of the main frame of the machine and through a pneumatic piston the frame and its load are rotated through 180 deg. to the pattern draw position on the other side of the machine.

Through an air-operated hydraulic control the pattern draw mechanism is raised until a levelling device makes firm contact with the inverted bottom board and it is rigidly clamped on the draw-piston head. When the box clamps have then been released and swung clear a vibrator is operated and the levelling device is lowered slowly at first and then rapidly under valve control. When fully lowered the levelling device clamps are released, allowing the bottom board to rest on

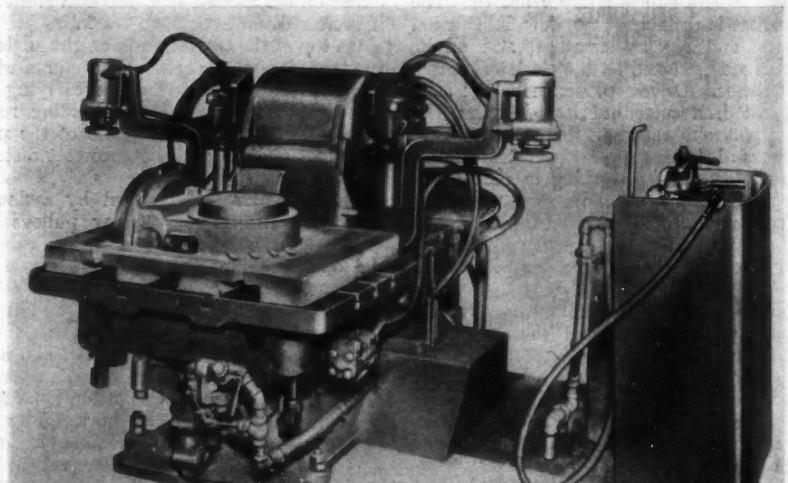

FIG. 19—ROCK-OVER JOLT MACHINE—JACKMAN

e rollers provided so that the base assembly n be pushed off.

For use in conjunction with core blowers here the weight of the corebox and design the core are too great for hand operation, e firm has introduced the rollover draw achine, illustrated in Fig. 20. The achine, as can be seen, consists of a lower reader beam with two end frames, which the top support a rollover table on unnions. Mounted at the centre of the reader is a twin hydraulic cylinder, the

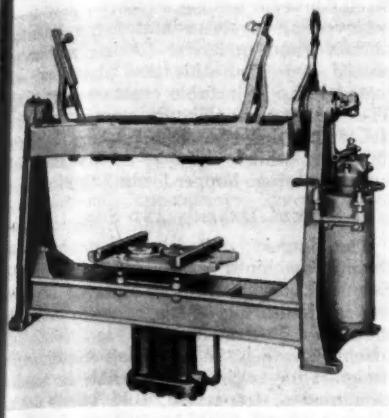

FIG. 20—COREBOX DRAW MACHINE—JACKMAN

plungers of which carry a head with support bars. The twin draw cylinders are actuated by oil under air pressure from a tank on one of the side frames, and the control valve is mounted on the top of the oil tank.

The table is provided with cleats, which have wedges corresponding to those fitted on the corebox, from which the core is to be drawn. A lever is provided for rolling the table over by hand, and the table is located either in the normal or inverted position by means of a spring-loaded pin mounted in

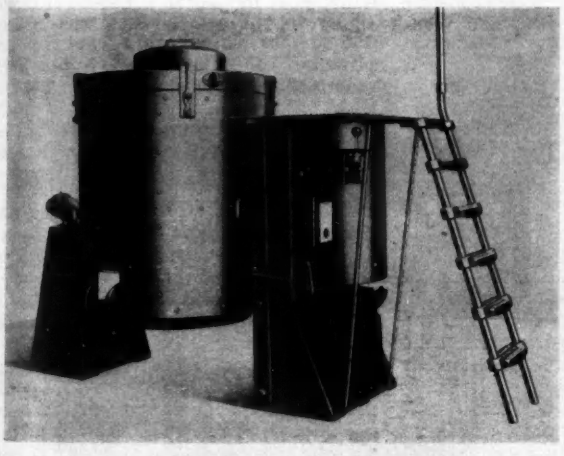

FIG. 21—POWER TILTED FURNACE—MORGAN

one end standard. The table is fitted with a pair of pneumatically operated clamps, which are adjustable both longitudinally along the table and also for height.

In operation, after the core box has been slid on to the table beneath the cleats, the core plate is attached to it by the pneumatic clamps before the table is rolled over. When the table has been rolled over the draw mechanism is raised so that the bars make contact with the core plate, the valve is then operated to give first slow and afterwards fast draw. At the end of the stroke the core, resting on its tray, is clear of the box and can be removed as desired. A pneumatic vibrator fitted to the side of the table is operated under separate valve control.

MORGAN CRUCIBLE COMPANY, LTD.

Amongst the display of crucibles, foundry accessories and furnaces arranged by the Morgan Crucible Company, Ltd., of Battersea Church Road, London, S.W.11, is the company's recently introduced power-tilted central-axis furnace. This unit is similar in all respects to the firm's original design of hand-operated tilting furnace, except that its gear is operated by an electric motor. Its speed of pouring is controlled by means of the selector handle to be seen by the platform in the photograph we reproduce on this page (Fig. 21).

A material of particular interest which will be noted amongst the refractories is the firm's recently introduced "M.R.1." This material is fired at a temperature which ensures volume stability under all conditions of normal loading at temperatures up to 1600 deg. Cent. When it is under load softening, it is stated, does not commence until 1600 deg. to 1650 deg. Cent., and 10 per cent subsidence takes place at 1750 deg. Cent. It is claimed by the makers to be highly resistant to thermal shock and strongly resistant to slag-laden gases, &c.

DONALD ROSS AND PARTNERS, LTD.

For some years the firm of Donald Ross and Partners, Ltd., of 1–3, Arlington Road, London, N.W.1, has specialised in the development and manufacture of holding and positioning equipment to facilitate and hasten the precision assembly of component parts by welding. On its stand at Olympia the firm is showing a wide range of special clamping and fixing devices together with hand and mechanically operated positioners. One of the positioners is illustrated in Fig. 23, and a set of turning rolls for assembling cylindrical components is shown in Fig. 22.

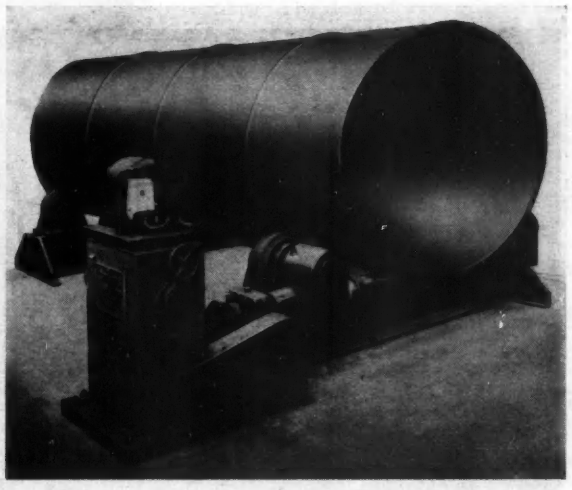

FIG. 22—TURNING ROLLS FOR WELDING—ROSS

The turning rolls consist essentially of a power-driven section and a number of idler sections, according to the length and weight of the workpiece, each section being designed to support work up to 2½ tons. Heavy-duty roll sections are also built by the firm for handling weights of 5 and 7½ tons.

In the power-driven section a 2 or 2½ h.p. motor (according to the weight capacity) of 960 r.p.m. is coupled through vee belts to a variable-speed gearbox which drives a 40 to 1 reduction gearbox through a roller chain. A further 30 to 1 reduction is given through a worm reduction gear flange-mounted on the front roller bracket of the unit. This second worm reduction gear drives, through a square shaft, a similar unit on the rear roller bracket. The two rollers are driven at infinitely variable peripheral speeds from 4in to 16in per minute.

The front roller unit is fixed to the main

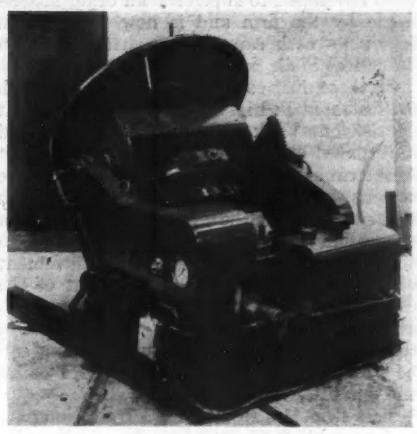

FIG. 23—WELDING POSITIONER—ROSS

beam of the section and the rear unit, which can slide along the beam, can be positioned and rigidly secured according to the diameter of the work to be welded. The rollers on both the power-driven and the idler sections of the equipment are mounted on heavy-duty bearings and fitted with rubber tyres.

The positioner shown in our illustration is one of the firm's heavy-duty power-driven units fitted with a 4ft diameter work plate. The machine is driven by a 4 h.p. electric motor and a hydraulic motor through a mechanical reduction gearbox.

The working head of the positioner is tilted through a triple-reduction worm and gear segment, and it can be moved through 135 deg. in forty-five seconds. Its top plate or work table can be rotated at any required speed in either direction between one revolution in 133 seconds and one revolution in forty minutes. The table is rotated by the hydraulic motor and when the machine is being used for manually welding heavy work its fastest speed is used to move the work

to a convenient down-hand position to give the most suitable weld sequence. For welding circular workpieces the speed of the table can be set to give smooth high-quality work.

Spencer and Halstead, Ltd.

Two new units have recently been added to the range of dust and fume-extraction equipment made by Spencer and Halstead, Ltd., of Ossett, Yorks. The first of these units, the "Spenstead" dust collector has been developed to supersede all other models made by the firm and is now available in four sizes with capacities from 500 to 1500 cubic feet of air per minute.

In these dust-collecting units, one of which is illustrated in Fig. 25, the filtering element consists of a bank of fabric screens supported and spaced by metal frames in the lower part of the cabinet. The air is drawn through the screens by a fan directly coupled to an electric motor in the upper compartment of the cabinet. When it is required to clean the screens they can be shaken by movement of the lever to be seen on the front of the cabinet, and the dust falls into a large removable container in the base. Installation of the units is facilitated as inlet spigots can be provided in any of the four sides or on the top of the cabinet as required.

This firm is also making a neat, compact and portable fume extractor for use in welding shops. This extractor has a magnetic suction hood with a flexible hose connection which greatly facilitates its positioning on a job close to the point of welding. Its built-in fan is driven by a ⅓ h.p. motor and has a capacity of 200 cubic feet of air per minute. An oiled glass-silk filter element absorbs the soot and dust from the fumes and can be quickly and easily replaced when saturated.

One of the company's "Centriblast" airless rotary table blast cleaning machines, which is exhibited, can be seen in operation in Fig. 24. On this machine the work to be cleaned is placed on the main turntable or on auxiliary turntables which rotate independently as they are carried through the blast stream in the main chamber of the unit. The number and size of the auxiliary tables can be varied according to the type of work, or a combination of main table surface with auxiliary tables can be used where both small and large work is handled.

In the shot blasting chamber the abrasive

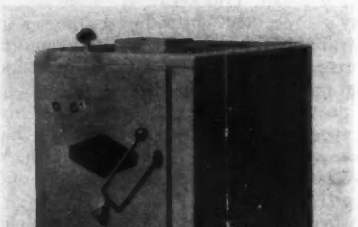

Fig. 25—Dust Collecting Unit—Spencer

is projected on the work by one or more high-speed impellers having heavy header wheels fitted with replaceable "Ni-Hard" alloy blades. The header wheels of the impellers are driven by 12½ h.p. motors, and each impeller is built as an independent unit. Abrasive is fed to the impeller through a renewable feed spout which is adjustable circumferentially to control the angle of discharge of the blast stream.

The work is carried through the blasting chamber on the upper of two heavy circular tables, the lower one of which is fitted with scrapers which return the abrasive mixed with foreign matter to a short scroll conveyor feeding into the boot of a vertical belt and bucket elevator. Both the upper and lower tables have peripheral driving rims which engage with rubber-covered driving pulleys driven through vee belts and reduction gearing by 2 h.p. motors. The lower table rotates at a higher speed than the upper table and when auxiliary tables are fitted they are driven by frictional contact between their pulleys and a rubber tyre fitted inside the rim of the lower table.

Dirty abrasive from the blasting chamber is deposited, by the elevator, on a short scroll conveyor feeding a rotary screen which removes all oversize material. Re-usable abrasive and undersize foreign matter are passed over a stratification plate and subjected to an adjustable cross current of air. The velocity of this air stream is set to deflect undersize particles into an expansion chamber, whilst clean re-usable shot falls into the storage hopper feeding the impellers.

Samuel Denison and Son, Ltd.

The largest unit shown amongst the testing machines exhibited this year by Samuel Denison and Son, Ltd., of Leeds, is the self-indicating 50-ton capacity universal machine illustrated in Fig. 26. This machine, which is fully self-contained, is designed for testing of materials in tension, compression, transverse, cold bend, double shear, hardness, punching and cupping, &c.

The frame of this machine consists of a massive cast iron base plate with four mild steel rods carrying two steel top beams. These beams are spaced by the straining gear cylinders and support the weighing levers; they carry both load action and reaction.

Pressure fluid for the two hydraulic cylinder units of the straining gear is supplied by a motor-driven high-speed, multi-piston, variable-displacement pump at the rear of the base plate of the machine. The straining cylinders have single-acting rams enclosing recovery springs, and although oil pressure is used to apply the load no measurement whatever is made of the pressure in the cylinders. Very fine control of straining is obtained by use of a bleed valve which allows oil to escape from the cylinders

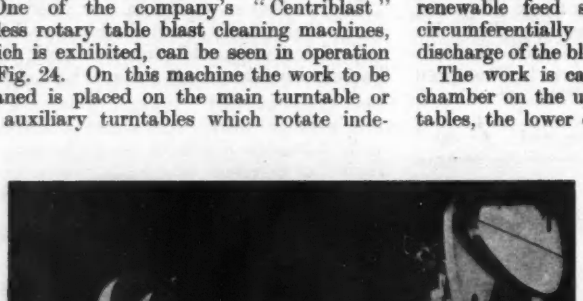

Fig. 24—Shot Blasting Machine—Spencer

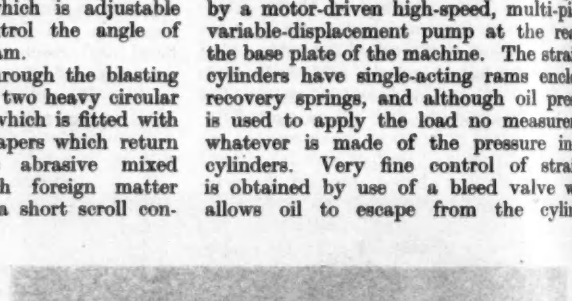

Fig. 26—50-Ton Universal Testing Machine—Denison

back into the tank. The return of the strainer head is controlled through a large valve which, when opened, allows a free flow of oil to the tank from the cylinders under the action of the return springs.

The weighing frame consists of the transverse beam and weighing wedge box with connecting-rods and main shackle. The transverse beam is arranged diagonally across the machine in order that long spans can be tested. The weighing frame is carried from a second order knife-edged lever fulcrumed on the top beams, and connected to an intermediate lever. This lever in turn is coupled to the dial unit through a weighing lever having four separate fulcrum knife edges. To select the required one of the four capacity ranges of the machine a push bearing is brought into contact with the appropriate fulcrum knife edge by the action of a cam operated by the capacity-change handwheel. When this handwheel is turned the appropriate figures of the capacity range appear at the windows of the dial chart.

The load on the specimen is indicated by the dial pointer on a graduated chart, and a second pointer moved by the "live" pointer indicates the maximum load applied during the test. The dial itself consists of a single circular scale, engraved with the minor markings of the chart. The major figures of the four capacity ranges and the corresponding values of the minor markings are carried on a disc behind a masking plate having sight holes. The self-weighing mechanism consists of a knife-edged steelyard having two weighing tension springs working in opposition. One spring is fitted on each side of the fulcrum knife-edge, to maintain contact between the knife-edge and bearing, and gives some damping effect. An oil dashpot is fitted to complete the damping.

The ranges of the machine are as follows:—Maximum, 0 to 50 tons in increments of 0·05 ton, or 0 to 112,000 lb in increments of 100 lb; half range, 0 to 25 tons in increments of 0·25 ton, or 0 to 56,000 lb in increments of 50 lb; fifth range, 0 to 10 tons in increments of 0·01 ton, or 0 to 22,400 lb in increments of 20 lb; tenth range, 0 to 5 tons, in increments of 0·005 ton, or 0 to 11,200 lb in increments of 10 lb. Its wedge box faces can be set from 1in to 24in apart and its compression faces 0 to 22in apart. For transverse tests specimens up to 3in wide can be tested in spans from 9in to 48in.

GENERAL ELECTRIC COMPANY, LTD.

An interesting solution to the problem of producing a.c. welding equipment which will take a balanced three-phase load from the supply mains at a high power factor, without the extra expense of a capacitor, is to be seen in the portable twin-arc set developed by the General Electric Company, Ltd., Magnet House, Kingsway, London, W.C.2.

The basic circuit of the twin-arc equipment is shown in Fig. 27. There are two parallel electrodes which are insulated from each other by their normal flux coating and are fed from a Scott-connected (three/two-phase) transformer. Very briefly, the successful operation of this system depends on the fact that, during welding, the effective resistance between each electrode tip and the workpiece is much less than that between the two tips. Consequently, the whole of the arc energy is concentrated into successively burning arcs from each electrode tip to the workpiece; only a very small, single-phase, component of current bridges the gap between the electrode tips.

The load taken from the transformer can, therefore, for practical purposes, be considered as balanced.

Furthermore, since ionisation due to the burning arc from one electrode assists in restriking an arc from the other electrode, and also because temperature fluctuation in the arc zone is reduced, the open circuit secondary voltage is much lower than the normal 80V, with a corresponding improvement in power factor. With the majority of electrodes a secondary voltage as low as 45V is possible, while the average power factor is of the order of 0·55. As a direct

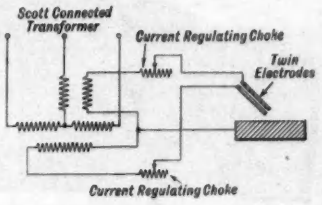

FIG. 27—3/2 PHASE TWIN METALLIC ARC CIRCUIT—G.E.C.

result of the improvement in arc stability the arc is quieter and much more easily controlled so that it is difficult even for a complete novice to deposit a bad weld.

Again, due to the improved thermal efficiency of the two-phase arc, and the fact that a larger total cross section of electrode can be used for a given size of weld, the rate of deposition as compared with single-phase welding is from 20 to 50 per cent faster, depending upon the size and kind of weld being produced. A further improvement in welding speed arises from the fact that twin electrodes of standard lengths deposit about 70 per cent greater length of weld metal than equivalent single rods, which means a considerable saving in time for rod changing. Experience has shown that on a $\frac{5}{16}$in fillet weld, the total saving compared with single-

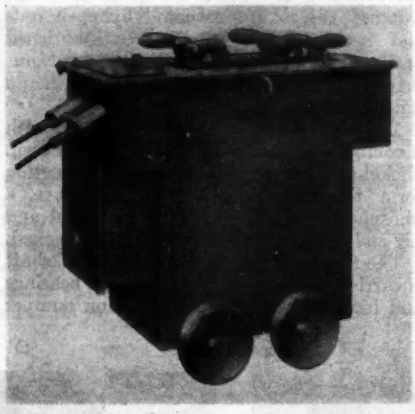

FIG. 28—TWIN ARC WELDING SET—G.E.C.

arc welding is of the order of forty-five minutes for each 100ft of welding, thirty minutes being due to greater welding speed, and fifteen minutes to less frequent rod changing.

Although the G.E.C. equipment is intended primarily for service as a twin-arc set, it can be used as a normal double-operator unit with independent control for each welder. For this purpose a voltage change-over switch is provided which gives 45V or 60V on the secondary terminals, the higher voltage being provided for single-arc welding. This facility is useful when special kinds of electrodes are necessary or when the equipment is used for tacking and intermittent welding operations in very confined spaces.

The twin-arc welding set consists of a three-phase to two-phase step-down transformer and choke units, the transformer primary being provided with tappings so that the set may be used with supply voltages covered by the range 360/440V. The secondary windings are connected in series with choke units which have fixed cores. Welding current variation is obtained in thirty-six steps by providing the choke windings with tappings which are connected to radial switches and give coarse and fine current regulation. The radial switches are operated by pistol-grip handles, which are provided with positive location in each position. Each handle must be lifted sufficiently to break one contact before re-engaging the next, so that there is no possibility of arcing taking place due to faulty contact in any position.

The tappings from the primary windings of the transformer are conveniently located at one end of the tank and are accessible on removing a cover plate. The welding terminals consist of shrouded plugs placed at one end of the set. The corresponding sockets are connected to the leads to the electrode holder, and are insulated with a tough sheathing capable of withstanding the rough treatment encountered in service. The terminal for the return lead is mounted on the end of the tank.

The complete assembly is contained in a robust steel tank (Fig. 28) and immersed in grade B transformer oil, and the tank is mounted on pressed steel wheels.

To extinguish the arc when the twin electrode is withdrawn from the workpiece, a relay-operated contactor automatically opens one of the three primary leads, thus causing a redistribution of the primary currents which, in turn, results in a voltage reduction across the electrode tips sufficient to extinguish the arc. The maximum voltage between the electrodes and the workpiece is reduced to 35V so that danger of shock to the operator is virtually eliminated. This contactor and relay are enclosed in a sheet steel case mounted at one end of the welding set. The electrode holder is designed for continuous use at a current of 250A per electrode—equivalent to 500A on single-arc welding. The electrodes are gripped between spring-loaded copper jaws, which can be renewed easily and are grooved to accommodate different sizes of electrode. The sockets for the two incoming cables are shrouded by an insulating tube which forms the handle and is readily removable for wiring the holder.

To provide a comparison with the more usual single-phase welding sets, both kinds of equipment are being demonstrated side by side.

The twin-arc welding process is also being demonstrated on the stand of the Quasi-Arc Company, Ltd., Bilston, Staffs. This company is the sole concessionaire for the G.E.C. twin-arc welding equipment.

JOHN I. THORNYCROFT AND CO., LTD.

The stand of John I. Thornycroft and Co., Ltd., of Southampton, carries examples of the wide diversity of the company's products, including small diesel engines, water-tube boilers, castings and models of ships and boats built at the firm's Southampton and Hampton-on-Thames yards.

From the range of diesel engines manufactured by the company a four-cylinder and a six-cylinder engine is shown. The four-cylinder engine (shown in Fig. 29) is a direct-injection, four-stroke unit, having a bore of 3$\frac{5}{8}$in by 4$\frac{1}{2}$in stroke, and developing 30 b.h.p. at 1750 r.p.m. The crankcase and cylinders are of monobloc design and cast in "chromidium" iron, renewable dry liners are fitted, and the cylinder head carries the valves and valve gear. The aluminium alloy

pistons, with toroidal combustion chambers in the crowns, have three wedge-section compression rings, and one slotted oil control ring. The connecting-rods are made of steel stampings and have small-end bearings of copper lead and big-end bearings of white metal, while the cast Meehanite iron crankshaft is carried in five white-metal lined bearings.

The air and exhaust valves, of special steel, are operated by push rods and rockers from a case-hardened and ground camshaft having integral cams. Fuel injection is by a pump driven by the timing chain and spur gears and a feed pump embodied in the injection pump draws the fuel from the tank. A mechanical governor controls the amount of fuel delivered. A rotary gear pump provides forced lubrication to the bearings and there is an oil cooler connected in the circulating water system. Sea water is circulated as a cooling medium by a gear pump running at half crankshaft speed and the water is ejected overboard via the exhaust pipe. Alternatively, a fresh-water closed circuit with either internal or external heat exchangers can be fitted to the engine.

The engine can be started by hand or arrangements made for electric starting. A standard, manually operated, reverse gear is fitted to the engine.

The six-cylinder engine (Fig. 30) operates on the four-stroke cycle. It has a bore of 4¾in, a stroke of 6½in, a compression ratio of 14·9 to 1, and develops a maximum of 125 b.h.p. at 1600 r.p.m. A deep section iron casting forms the crankcase through which pass long nickel-chrome steel bolts for securing the cast monobloc cylinder and the main bearing caps. The sump is of cast iron and also the cylinder heads, each of which cover three cylinders, and carries the valves and valve gear. Both the inlet and exhaust valves are actuated by push rods and rockers from a single case-hardened and ground camshaft, having integral cams, driven by a roller chain fitted with an automatic tensioner.

The pistons are of aluminium alloy, with a combustion chamber formed in the crown. Nickel-chrome steel stampings of H-section form the connecting-rods, which have a phosphor-bronze bush at the small-end and big-end bearings of copper-lead, steel backed.

The forged hardened alloy steel crankshaft is carried in seven copper-lead-lined bearings and has a bonded rubber vibration damper fitted externally at the forward end.

The engine is designed to use light diesel oil. A feed pump mounted on the injection pump draws fuel from the tank and the injection pump is driven by the timing chain and spur gears from the camshaft. An all-speed governor controls the engine under the worst sea conditions. A rotary gear pump maintains the forced feed lubrication system, in which there are two oil pressure relief valves. A thermostatically controlled oil cooler is incorporated in the sea water circuit. Cooling is on the closed system, the fresh water being circulated by a centrifugal pump and cooled by a heat exchanger through which sea-water is circulated by a second centrifugal pump. Electrical starting is provided, the axial starter motor engaging with a toothed ring on the flywheel, and the dynamo is driven from the timing chain through a flexible coupling.

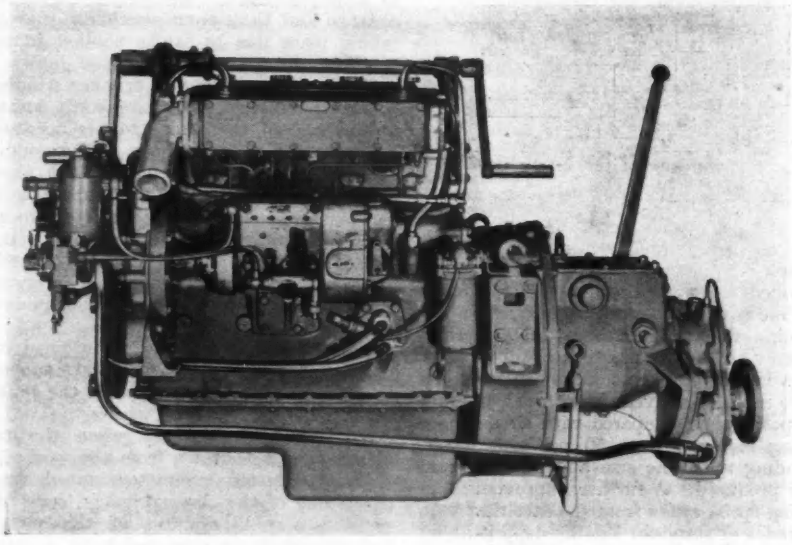

FIG. 29—40 B.H.P. MARINE ENGINE—THORNYCROFT

C. A. PARSONS AND CO., LTD.

On the stand of C. A. Parsons and Co., Ltd., Newcastle upon Tyne, are a completely bladed, high-pressure turbine shaft and turbine cylinder. The turbine shaft (shown in Fig. 32) is intended for a three-cylinder turbo-alternator generating 60MW at 3000 r.p.m., the steam conditions being 900 lb per square inch and 900 deg. Fah. On this shaft the blading is arranged on a constant mean diameter so that only a single dummy is required to balance the steam thrust on the blades, which are of stainless iron and end tightened. The cylinder, which is adopted to meet the new level of working pressure and temperature, is shown in Fig. 35. It incorporates a design in which the vertical bolting for the horizontal joint is eliminated, the two halves of the cylinder being held together with clamps. The constant mean diameter blading arrangement has allowed a straight and parallel flange to be obtained and so facilitated machining and clamp fitting.

A scale model of the 10MW, 3000 r.p.m. gas turbo-alternator, which the company is constructing for the National Gas Turbine Establishment, is shown and illustrated in Fig. 33. The model shows the appearance of the turbine, compressor, combustion chambers and heat exchangers of the machine, which operates on the open-cycle principle and is of two-stage design, there being no mechanical couple between the l.p. and h.p. systems. The l.p. turbine

FIG. 30—125 B.H.P. MARINE ENGINE—THORNYCROFT

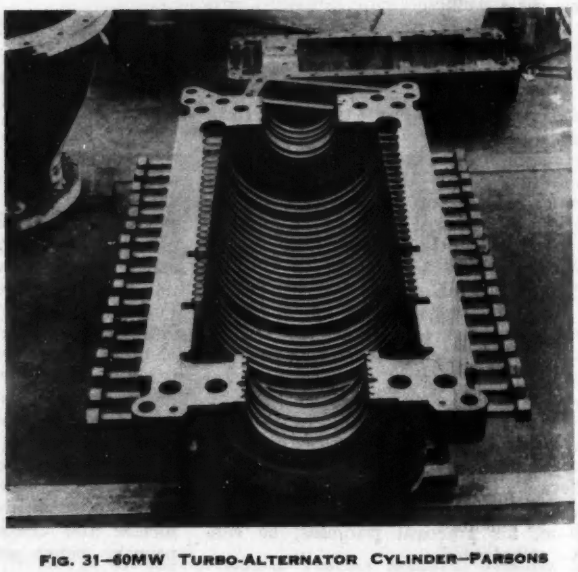

FIG. 31—60MW TURBO-ALTERNATOR CYLINDER—PARSONS

l.p. compressor are on one shaft, together with a 350 h.p. starting motor, and on the other is the h.p. turbine, h.p. compressor, 10,000kW alternator and 450 h.p. starting motor. The starting motors, which have hydraulic couplings, take the machine up to approaching half-speed and are auto-

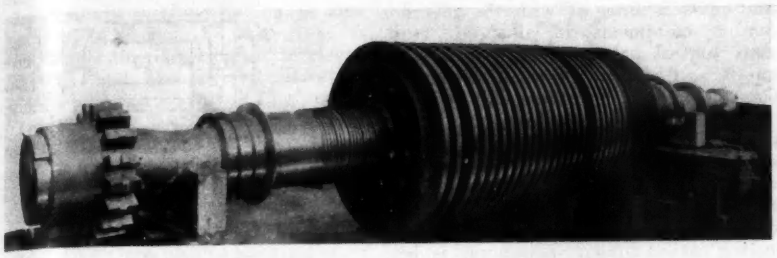

FIG. 32—60MW TURBO-ALTERNATOR SHAFT—PARSONS

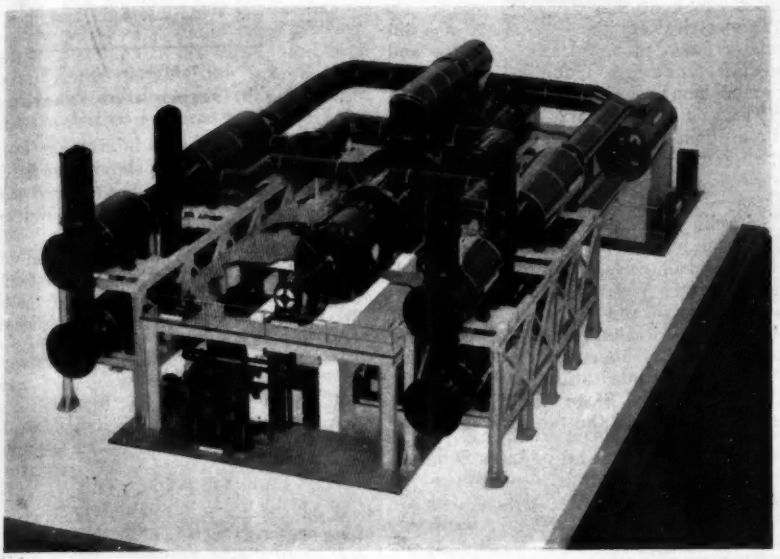

FIG. 33—MODEL OF 10MW GAS-TURBO-ALTERNATOR—PARSONS

matically cut out when the machine takes over on gas power.

On starting, air is drawn into the l.p. compressor and passes through an intercooler before entering the h.p. compressor, from where it is circulated through an air-gas heat exchanger before being led to the combustion chamber. The combustion products pass first to the h.p. turbine and then to the l.p. turbine, from where the exhaust gases pass through a contra-flow heat exchanger, in which the temperature of the combustion air supply is raised before being led to a waste-heat exchanger, which, together with auxiliary oil-fired boilers, will provide hot water to the surrounding buildings.

LINCOLN ELECTRIC COMPANY, LTD.

Among the welding machines exhibited by Lincoln Electric Company, Ltd., Welwyn Garden City, Herts, is the new "SA 200," which consists of a d.c. welding generator driven by a direct-coupled Fordson petrol engine (Fig. 34).

The generator is a single-operator, variable-voltage machine fitted with interpoles and designed for a current range of 40A to 300A and an arc voltage of 40V. Its magnetic circuit (both frame and pole pieces) is fully laminated. Dual control of the welding current is accomplished, as in other Lincoln equipments, by adjustment of both shunt and series fields. The open circuit voltage can be adjusted in a number of fine steps on a shunt field regulator; the welding current can be varied, independently of the open circuit voltage, by series field control. To improve welding performance the main generator is separately excited.

An idling device allows the machine to run at low speed when not welding; on striking arc the speed automatically increases, by throttle control, to the normal governed value. An adjustable period of about fifteen to thirty seconds is provided between the time of interrupting the arc and the slowing down of the engine. This time delay ensures that the engine speed will be maintained during the normal momentary inter-

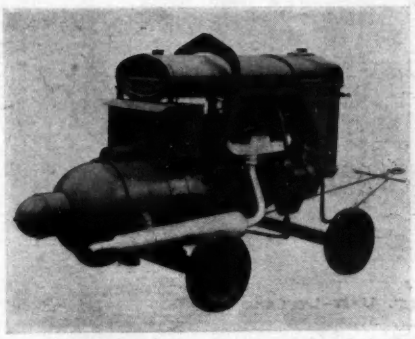

FIG. 34—"SA200" PETROL ENGINE DRIVEN WELDING SET—LINCOLN

ruptions of welding. During definite breaks of longer duration the idling speed effects a useful saving in fuel and oil and a reduction in engine wear.

The generator frame is fitted directly to the engine housing, the generator shaft being direct-coupled to the engine flywheel. The engine is a Fordson "Major" four-cylinder tractor engine, of 4⅛in diameter bore and 5in stroke, developing 38 b.h.p. maximum at 1500 r.p.m. This engine is a side valve unit with a monobloc top half crankcase and cylinder casting, and detachable cylinder head. Solid, skirt type cast iron pistons are fitted. The engine has a centrifugal ball governor, a Ford downdraught carburetter and a Lucas or Wico magneto. Hand starting only is provided.

TRIER BROTHERS, LTD.

In addition to its familiar lubricants and lubricators, Trier Brothers, Ltd., of Caldew Street, London, S.E.5, is making a special show of its "Collgraf" lubrication system for steam and hot water plant, and its "Staufferlube Multigreasor" multi-point grease lubricator.

The "Collgraf" system usually consists of a hydro-mechanical apparatus which, through an atomiser, injects the "Collgraf" compound, an aqueous suspension of colloidal graphite, into the steam stream. The feed apparatus consists of an adjustable displacement pump which builds up pressure under a floating piston, on top of which is contained a standard dilution of lubricating compound. The pressure and quantity of the compound injected into the steam stream are indicated by a pressure gauge and a sight feed drip glass on the apparatus.

Three models of the "Staufferlube Multigreasor" are shown—a hand-operated unit

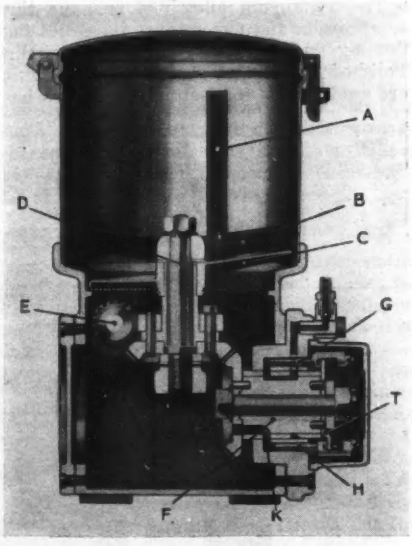

FIG. 35—MULTI-POINT GREASING UNIT—TRIER

with sixteen outlets, a ratchet or rotary-driven unit with up to twelve outlets and capable of operating pressures of 750 lb per square inch, and power-driven units with up to twenty-four outlets and an outlet capacity of up to 1500 lb per square inch for points over 1000ft from the pump.

The arrangement of one of the new greasing units is shown in Fig. 35. Grease in the main container at the top of the unit is fed down through a perforated strainer plate into the main body reservoir forming the lower half by a scraper *A*, a paddle *B*, and a spiral feed plate *C*. The main spindle *D* of the unit is driven through gears from the shaft *E*. Drive from this main spindle, which also actuates the scraper, paddle and feed plate, is transmitted through bevel gears to a rotating pump assembly *F*. Pistons in the pump body are actuated by a cam plate *T* at

the rear end of the rotating inner assembly of the pump.

In the sequence of operations when a groove *K* on the pump body is open to the suction of one of the pistons, *H*, the cam plate draws the piston back to fill the groove with grease from the reservoir. With the continued rotation of the inner assembly the groove inlet is then sealed off. When the groove comes to a position *G* opposite the delivery, the piston is actuated by the fall in the cam to push grease out of the groove into the delivery channel leading to the lubricating feed line. The effective length of piston stroke, and thus the amount of grease delivered on each revolution of the pump, can be set by means of screws at the rear of the pistons.

LEYLAND MOTORS, LTD.

Six different industrial diesel units are shown on the stand of Leyland Motors, Ltd., of Leyland, two being self-contained power installations, one of which (shown in Fig. 36) employs a newly designed 63/90 b.h.p. engine of 350 cubic inches capacity. It is a direct-injection, four-stroke, six-cylinder, overhead-valve, water-cooled engine having a bore of 3·96in by 4·75in stroke, and a compression ratio of 16 to 1. The crankcase is of cast iron and cast integrally with the cylinder block, which is fitted with cast iron, pre-finished dry liners having a sliding fit. Also of cast iron is the cylinder head, which has frozen-in "Valmet" metal exhaust-valve seat inserts, renewable cast iron valve guides, and Leyland remote-seat, multi-hole "Aphonic" injectors.

The aluminium alloy pistons have three compression and two scraper rings and fully floating gudgeon pins retained by circlips. Polished alloy steel stampings of I-section are used for the connecting-rods, which have small-end bearings of phosphor-bronze and big-end bearings of lead-bronze, indium-coated and steel-backed. The crankshaft is a nitrided alloy steel forging with integral balance weights, and it is carried in seven steel shell, lead-bronze, indium-coated bearings. The overhead valves are push-rod operated from a forged steel camshaft, with integral cams and carried in four bearings, the front and rear bearings being of leaded gun-metal. This camshaft is driven through idler gear by a helical gear from the front end of the crankshaft. Nitrided chromium molybdenum alloy steel is used for the inlet valves and silicon-chromium alloy steel for the exhaust. The crankshaft is fitted with a rubber-bonded torsional vibration damper.

A C.A.V. enclosed camshaft fuel-injection pump, having a positive drive from the timing gears is integral with the governor which is of pneumatic all-speed, twin-venturi control pattern. On the injection pump is a fuel lift pump of diaphragm design having a maximum lift of 6ft. All main and crankpin bearings, timing gear, camshaft and valve gear are pressure lubricated by a gear pump, which has a delivery of 4½ gallons per minute at 1000 r.p.m. Cooling is by fresh water circulated by a centrifugal pump, with a self-adjusting carbon gland. This pump is belt driven at 1·5 times the engine speed and incorporates a thermostat to give main and by-pass flow control.

The electrical equipment consists of a 5in diameter flange-mounted starter motor and 5in diameter swing mounted, belt-driven dynamo. The unit includes a cooling system of 8¾ gallons capacity, a 24V, 75Ah battery, and a 30-gallon fuel system.

EXACTOR, LTD.

Hydraulic power control units for a wide range of industrial applications are shown on the stand of Exactor, Ltd., of 108, Park Street, London, W.1, together with demonstration units of the "Trabon" system of centralised lubrication which the company is now making in this country under licence.

This system of lubrication has been widely used in the United States for a number of years and with it all the bearings on one or a group of machines can be fed with predetermined amounts of grease or lubricating oil manually or automatically through a central pump. The lubricant is fed to a group of feeders, one at each lubricating point, through a single line in which the flow of oil or grease is reversed after each pumping operation. By this arrangement in each lubricating cycle the lubricant passes through each feeder in turn and on the next cycle the direction of flow is reversed and the cycle completed in the other direction. Feeders of various capacities are made to supply the requisite amount of lubricant to bearing surfaces and a number of different size feeders can be used on the same circuit.

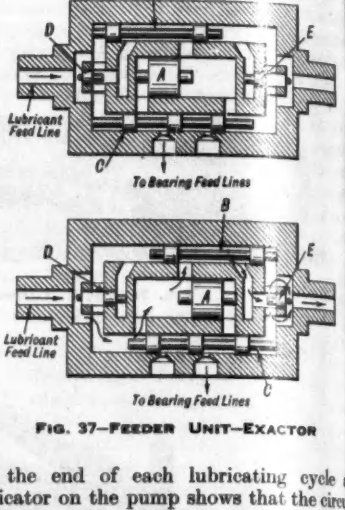

FIG. 37—FEEDER UNIT—EXACTOR

At the end of each lubricating cycle an indicator on the pump shows that the circuit has been completed and the metered quantity of oil or grease has been supplied to the bearings.

The construction and operation of the feeder unit is shown diagrammatically in Fig. 37. The main chamber of the feeder block contains a piston *A* and two slide valves *B* and *C*. In the first operating cycle a quantity of lubricant in accordance with the predetermined requirements of a bearing or bearings is deposited in the main chamber of the feeder in front of piston *A*. When the flow in the main feed line is reversed—that is, to come from the left-hand side in the upper diagram—it first moves the primary piston *D* and the two valves across the feeder block to the positions shown in the lower diagram. The feed of pressure liquid then forces the piston

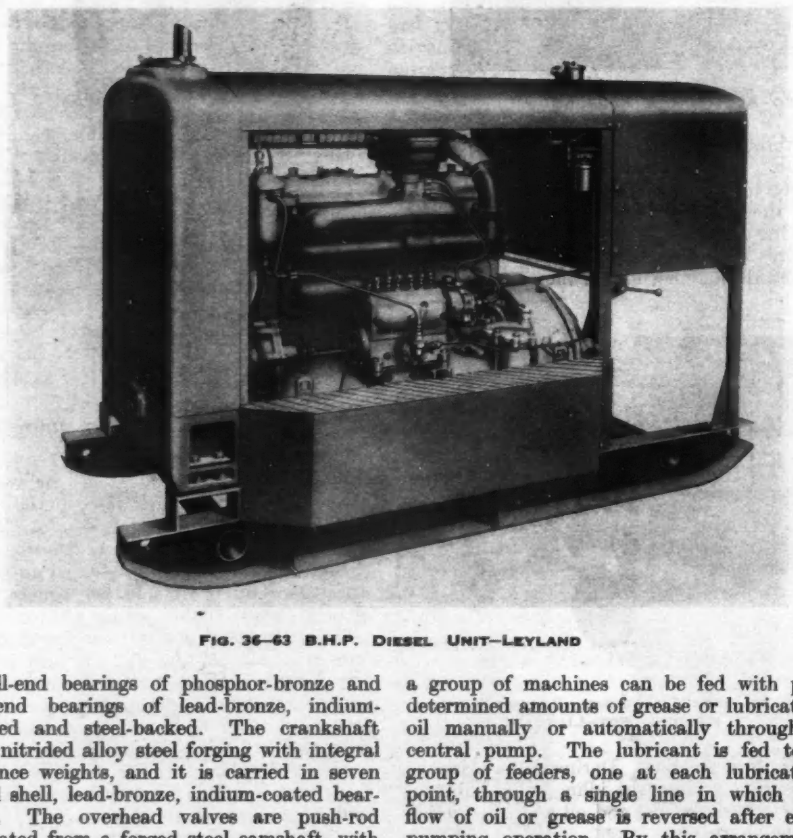

FIG. 36—63 B.H.P. DIESEL UNIT—LEYLAND

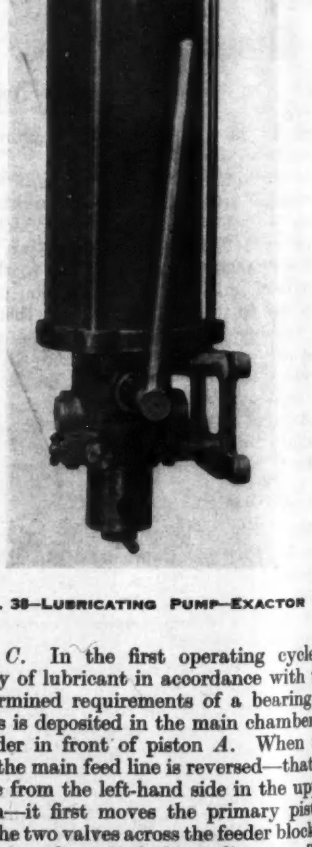

FIG. 38—LUBRICATING PUMP—EXACTOR

long to eject the lubricant which is trapped in the chamber on its other side through the port opened by the valve *C* into the bearing feed line. When the piston reaches the end of its stroke it exposes a port in the chamber through which an unrestricted flow of pressure lubricant passes freely via the valve chamber of *B* to the outgoing feed line leading on to the next feeder. This cycle of movements continues through each feeder in the line until the pump is reached.

At the pump the direction of lubricant travel in the feed line is reversed either mechanically or manually according to the kind of pump. On the commencement of the reverse flow of lubricant the primary piston *E* and the valves are first moved back to the positions shown in the upper diagram and the lubricating cycle is repeated.

Feeder units in various sizes to discharge from 0·01 cubic inch to 2 cubic inches of lubricant per stroke are available and, if required, two outlets of one feeder or the outlets of several feeders can be coupled by a manifold to serve a single large bearing. It is also possible to discharge one large reversible feeder in the line into a non-reversible feeder arranged to discharge lubricant in desired amounts to a number of individual points.

A single manual pump can be used to supply up to three reversible lubricating circuits through a selector valve, and an automatic pump can be arranged to serve more than one circuit when used in conjunction with a manually operated selector valve. Under favourable installation conditions with suitable lubricants the makers say that it is possible to use main feed lines of this system up to 500ft long. Generally, however, it is desirable to keep the length of lines with ¼in diameter piping below 300ft and ⅜in piping below 150ft. As more than one circuit can be installed from the same pump it is not often necessary to exceed these pipe lengths.

In the illustration, Fig. 38, can be seen one of the largest hand-operated pumps made by the firm for this system of lubrication. Between lubricating cycles the flow of lubricant to the line is reversed by movement of the lever at the bottom of the unit.

Auto-Diesels, Ltd.

On the Leyland stand there are also exhibited a number of Leyland Auto-Diesel generators manufactured by Auto-Diesels, Ltd., of Uxbridge. One model, seen in Fig. 39, is a three-phase, 50 c/s, 400/230V, 75kVA equipment, which includes a six-cylinder, vertical, totally enclosed Leyland water-cooled diesel engine having a 4·8in bore by 5·5in stroke, and developing 90 b.h.p. at 1500 r.p.m., driving a screen-protected generator of fully compensated design with an exciter mounted on the frame and driven by vee belts.

The latest design of generator set also shown embodies a Leyland horizontal engine which reduces the overall height of the complete unit and makes it suitable for mounting on a trailer. The arrangement lends itself to easy maintenance as major overhauls can be undertaken without removing the engine from the bed-plate. The engine is of direct-injection, four-stroke design having six water cooled cylinders and overhead valves. The cylinders have a bore of 4·8in by 5·5in stroke and a compression ratio of 15·75 : 1, the continuous rating being 95 b.h.p. at 1600 r.p.m.

The crankcase of cast iron is integral with the cylinder block, which is fitted with press-fit, dry, cast iron, pre-finished cylinder liners. The cast iron cylinder heads have renewable valve guides and stellite-faced valve seat inserts, while the valves are of special heat-treated alloy steel, stellite faced, and have chromium-flashed stems. The pistons are of aluminium alloy and have three compression and two scraper rings and fully floating gudgeon pins. The connecting-rods are polished stampings of alloy steel. The crankshaft, which is a nitrided alloy steel forging with integral balance weights, is carried in seven bearings of copper-lead, indium-coated and steel-backed, and is fitted with a bonded rubber torsional vibration damper. A camshaft of forged steel and with integral cams, is driven through idler gear by helical gear from the crankshaft and it has seven bearings, the front and rear being of leaded gun-metal and the intermediate of carobronze.

There is an enclosed camshaft fuel injection pump having a positive drive from the timing gears, which are hardened and ground helical gears driven from the front of the crankshaft. Mounted on the camshaft is a diaphragm fuel pump having a maximum lift of 6ft. Lubrication is by a gear pump which has a delivery of 6 gallons per minute at 1000 r.p.m., and there is a wet sump of 5½ gallons capacity. Cooling water is circulated by a centrifugal pump, belt driven at one and a half times the engine speed. The cooling system incorporates a thermostat to give main and by-pass flow control. Speed control is by a combined pneumatic and mechanical governor.

The alternator is a "Magnicon," developed by the Macfarlane Engineering Company, Ltd., of Glasgow, and the exciter automatically keeps the alternator voltage constant and provides a straight-line voltage characteristic within plus or minus 2½ per cent at all loads and frequencies without the aid of an external voltage regulator.

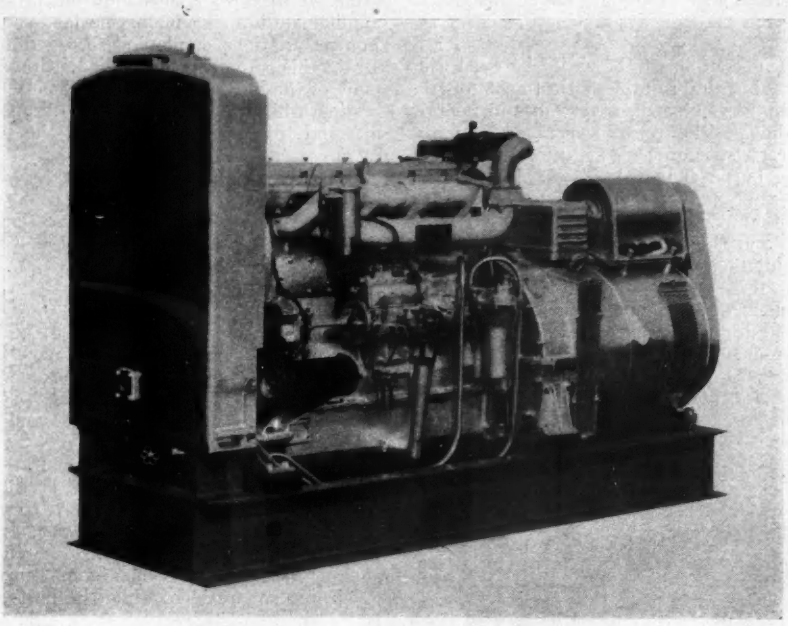

FIG. 39—75kVA GENERATOR—AUTO-DIESELS

British Combustion Equipment, Ltd.

Several examples of its most recent designs of burners for heavy fuel oil, coal tar fuels and gas for marine and industrial purposes are to be seen upon the stand taken by British Combustion Equipment, Ltd., of Poole, Dorset. A typical pumping and heating marine set exhibited has the strainers, pumps and heaters duplicated for standby purposes.

One of the company's type "18F" forced draught burners for preheated air is arranged so that its construction and design can easily be inspected. Details of this

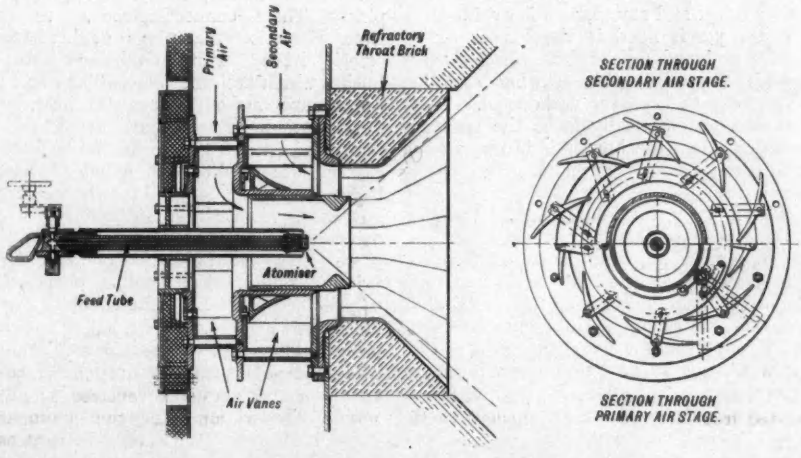

FIG. 40—LIQUID FUEL BURNER—BRITISH COMBUSTION

burner can be seen in the drawing we reproduce in Fig. 40. In these burners the rotating flow of primary air is admitted to the sprayer in such a way that a depression in the centre of the free vortex maintains flame stability, whilst at the same time the issuing particles of fuel are in contact with a very large amount of air. With this arrangement, the makers point out, a clear smokeless flame is produced over a range of fuels with the minimum amount of combustion air. The remainder of the air for combustion is delivered through a secondary stage of the unit.

Flame contour can be varied between wide limits by the suitable adjustment of the primary and secondary air vanes in relation to the position of the sprayer and the characteristics of the " Uni-tip " atomiser.

The burner is built up of cast iron streamlined vanes mounted on pillar studs in such a way that distortion and jamming is eliminated, and the burners have a long effective working life.

In this design of sprayer the orifice atomiser, whirl chamber and cap nut are all formed in a single unit called the " Uni-tip." This unit simplifies the changing and cleaning

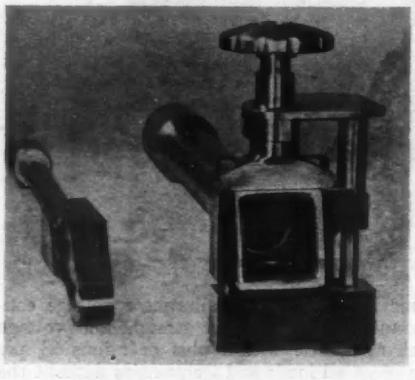

FIG. 41—SPRAYER AND BURNER COUPLING—BRITISH COMBUSTION

of sprayers and avoids necessity for the handling and assembling of various discs and atomisers parts by unskilled personnel. The correct ratio between the tangential grooves in the atomiser and diameter of whirl chamber in relation to the size of orifice fixes the characteristics of the oil spray. The sprayer has a small-bore feed tube leading from the inlet to the orifice, and as the quantity of oil contained in the sprayer between the shut-off valve and the orifice is quite small lighting up and shutting off is almost instantaneous. With this rapid operation any tendency towards carbonisation at the end of the sprayer due to the dribbling of cold oil on shutting down and starting up is avoided.

The sprayer is fixed in the burner by a specially designed quick-release mechanism, which is shown in the drawing and in Fig. 41 with the sprayer withdrawn. This mechanism automatically locks the sprayer in position when the burner is in operation, and to withdraw the sprayer the hand wheel must be turned through 90 deg. to the position shown in the photograph. When it is in this position the hand wheel is over a pinching screw, which shuts off oil feed to the burner. Oil feed is controlled by a steel plug valve in the bottom of the block and locking is by a simple differential screw. The upper pinching screw is shrouded in the hand wheel quadrant. The bottom block of the mechanism incorporates the oil inlet connection and the male portion of the oil coupling which makes a metal-to-metal joint with the sprayer. When the pinching screw holding the sprayer is released the male coupling automatically retracts into its housing in the block and is protected from possible damage due to careless handling. The fuel oil supply cannot be turned on until the sprayer is in position in the burner and the joint with the male portion of the coupling made.

When forced draught is used the burner is attached to the air casing by means of an annular sealing ring in marine installations. For installations employing forced draught air at high temperatures the entire front plate of the burner is made of a deep-section casting, which may be packed with insulating material to prevent radiation to the boiler room.

Specially designed brickwork quarls, which are supplied as standard with each burner, are made in a small number of sections to simplify installation and ensure the correct form of air flow to the flame.

J. AND H. MCLAREN, LTD.

Among the engines shown by J. and H. McLaren, Ltd., of Leeds, are two new " M " marine and industrial engines which are a development of the " MR " series. The " M 4 " develops 88 b.h.p. and the " M 5 " develops 110 b.h.p. at 1000 r.p.m., both engines being vertical, four-stroke, direct-injection, compression-ignition units. Engines are available having two to eight cylinders of $5\frac{2}{16}$in bore by 7·9in stroke the compression pressure being 480 lb per square inch and the maximum pressure 900 lb per square inch, while the b.m.e.p. is 90 lb per square inch.

The " M 4 " engine has a sump fabricated from mild steel and a similar form of construction serves for the crankcase, which carries the camshaft and tappets. The cast iron cylinder blocks are fitted with renewable wet liners and the cast cylinder heads incorporate two air inlet and two exhaust valves and an atomiser. The inlet passages are designed to create turbulence in the combustion chamber, the turbulence being increased by masked inlet valves. A common passage connects the exhaust valves. Two separate levers, push-rod operated, control one pair of valves, and for decompression the exhaust valves are lifted by the rotation of a shaft housed in the valve casing. A water-cooled, multi-hole atomiser is centrally disposed between the four valves, the fuel being sprayed into a bowl-shaped combustion chamber formed in the piston crown.

Each of the aluminium alloy pistons has four compression rings, one scraper ring and pressure-lubricated, fully floating gudgeon pins. The connecting-rods, machined from H-section stampings of heat-treated steel, have white-metal-lined big-end bushes which are renewable. The small-ends are bronze bushed, and metal-lined, brass-backed, main bearings are fitted. A fuel pump, operated by a rocker lever from the camshaft, is fitted to each cylinder in association with a spring-loaded centrifugal governor. Lubrication is effected by a gear-driven oil pump having a relief valve, and there is a hand-operated lubricating oil priming pump. For cooling purposes the engine incorporates a heat exchanger which is used when operating on closed-circuit cooling, but other alternatives are available. The drive is through a " Meadows " reverse-reduction gearbox and the engine is equipped with " Tandem " self-priming pumps, one for heat-exchanger circulation and one auxiliary services. The specification the " M 5 " is similar to the " M 4 " exc that the sump and crankcase are of c iron and the fuel pumps are driven from timing gears.

A. REYROLLE AND CO., LTD.

Horizontal draw-out switchgear for 33 and various examples of induction moto commutator motors and arc welding equ ment are being shown by A. Reyrolle & Co., Ltd., Hebburn, Co. Durham.

Of the two single-operator arc weldi sets exhibited, one incorporates the concent dual control device recently introduced the company. With this method of cont different welding characteristics can selected at will to suit various conditio and positions of welding. The welding (Fig. 42) is a composite unit made up o d.c. welding generator and a squirrel-c induction motor mounted on a comm shaft between two ball or roller bearing on top of the frame is a control box contain the generator controls and motor start

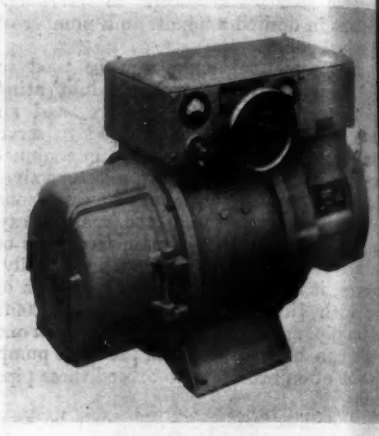

FIG. 42—WELDING SET WITH DUAL CONCENTRIC CONTROL—REYROLLE

The generator is a compound-wound type machine with a drooping characteristic, striking voltage of 70V, a current range 20A to 300A at 20 to 30 arc volts, and rating of 200A continuous hand welding B.S. 638 or 300A for intermittent weldin Special injector field connections are incor porated to give maximum transient respons under welding conditions and to allow a wi range of adjustment to suit work of all kind and sizes, including ferrous and non-ferrou metals and carbon and all-metallic electrode

The squirrel-cage motor normally has synchronous speed of 1500 r.p.m. and designed for any supply voltage up to 650V Thermal overload protection is provided b a self-resetting switch with a sensitiv element in contact with the stator winding Standard starting equipment takes the form of push-button-operated, air-break, star delta or direct-on starters housed in th control box.

Current settings to suit any condition operation are obtained simply by selectin the required current range on the outer concentric scale of the dial plate. For thi setting there are two pointers—a yellow pointer for down-hand welding, and a re pointer for overhand and vertical welding Adjustments to suit the welding condition are then made by setting the central knob and pointer against the appropriate sub division of the inner scale.

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